101654

Distribution

Unit Managers' Meeting: 300 Areas Remedial Action Unit/Source Operable Units

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Please inform Michael Wetzler (372-9562) – BHI (H0-17)
of deletions or additions to the distribution list.

Meeting Minutes Transmittal/Approval
300 Area Unit Managers' Meeting
Remedial Action and Waste Disposal Unit/Source Operable Unit
3350 George Washington Way, Richland, Washington
May 2002

APPROVAL: Robert G. McLeod Date 6-20-02
Robert G. McLeod, 300-FF- 1 & 300-FF-2 Area Unit Managers, RL (A3-04)

APPROVAL: Kevin Leary Date 6-20-02
Kevin Leary, 618-10 & 618-11 Area Unit Manager, RL (A6-38)

APPROVAL: K. Mark Thompson Date 7/30/02
Mike Thompson, 300-FF-5 Area Unit Manager, RL (A5-13)

APPROVAL: John B. Price Date 7/11/02
John B. Price, Cleanup Project Manager, WDOE (B5-18)

APPROVAL: Mike Goldstein Date 6/19/02
Mike L. Goldstein, 300 Aggregate Area Unit Manager, EPA (B5-01)

Meeting minutes are attached. Minutes are comprised of the following:

Attachment 1	--	Agenda
Attachment 2	--	Attendance Record
Attachment 3	--	300 Area Meeting Minutes – May 14, 2002
Attachment 4	--	Previous Open Action Items List
Attachment 5	--	Current Action Items List
Attachment 6	--	300 Area Activities Schedule
Attachment 7	--	Nonradioactive Air Emissions Evaluation for the Handling of the 618-4 and 618-5 Drums
Attachment 8	--	Comment Response Package to Technical Expert Review of the Preliminary Results for the Kd/Leach Study of 2001 and the Draft Uranium Conceptual Site Model White Paper

Prepared by: _____ Date 7/31/02
Jenifer Linville/ Michael Wetzler (H0-17)

Concurrence by: _____ Date 8/1/02
Vern Dronen, Project Manager
BHI Remedial Action and Waste Disposal Project (H0-17)

UNIT MANAGERS MEETING AGENDA

3350 GWW 1B40
May 14, 2002, 12:30-2:30 p.m.

300 Area

Administrative (12:30 – 1:00)
- Action Item List
- Next UMM is June 18, 2002, 1:30 – 3:30, 3350 GWW (1B45)

Crossover Items (These items will be discussed at next 100UMM)
- *Site Wide Institutional Controls Plan*
- *TPA Milestone Negotiations (M-16-00B)*

300-FF-1 Remedial Action (1:00 – 1:30)
- 618-4 Mobilization Status
- Drum Treatment Technologies
- Spill Reporting

300-FF-2 (1:30 – 2:00)
- 618-11 Benchmarking
- Outside The Fence Design
- RDR/RAWP/SAP
- Kd/Leach Study

300-FF-5 (2:00 – 2:30)
- 300-FF-5 O&M Plan / SAP
- 300 Area Shoreline Study

Meeting Minutes Schedule

- Draft – 1 week
- Distribute – 1 Day
- Review – 1 week
- Incorporate – 1 week
- Finalize – Next UMM

Attachment 2

Remedial Action and Waste Disposal Unit Managers' Meeting
Official Attendance Record – 300 Area
May 14, 2002

Please print clearly and use black ink

PRINTED NAME	ORGANIZATION	O.U. ROLE	TELEPHONE
Larry Hulstrom	CHI	Technical Support	372-9602
Kevin Leary	DOE	618-10/11	373-7285
Richard Carlson	BHI	300 Area	372-9632
Mike Goldstein	EPA	300 Area	376-4919
K. Michael Thompson	DOE-RL	300 FF5	373-0750
Bob McLeod	DOE	UM	372-0096
Ella Evenenberg	CHI	300 Area	372-9141
Jessica Kious	BHI	300 Area	372-9524
Pam Doctor	BHI	Risk Assess	372-9107
Roger Ovink	CHI	300-FF-5	375-9426
Frank Corpuz	BHI	PFI/2 Project Engineering	531-0625
Jeff Lerch	CHI	300 Area	373-5904
John Price	Ecology	Proj. Mgr	736-3029
Jenifer Linville	CHI	Tech. Support	372-9613

MEETING MINUTES
REMEDIAL ACTION AND WASTE DISPOSAL
UNIT MANAGER'S - 300 AREA
3350 GWW-- Room 1B40 -- 1:30-3:30 p.m.
May 14, 2002

Review of Open Action Item List: (Attachment 5)

The next UMM is Tuesday, June 18th, 2002, 1:30-3:30 p.m., 3350 GWW/1B45

CROSSOVER ITEMS (Discussed at the 100 and 300 Area UMMs)

- ***Sitewide Institutional Controls Plan.*** Public comments were received on the Sitewide Institutional Controls Plan by the Nez Perce, Benton County, and the Washington State University Consortium. Discussions specific to the 300 Area are documented under the RDR heading.

- ***TPA Milestone Negotiations (M-16-00B).*** The Tri-Party Agreement Milestone negotiations were completed and new milestones approved by the Tri-Parties. A completion letter was sent out on May 13th, 2002. These milestones will be incorporated into the 300-FF-2 RDR/RA Work Plan. Responses to comments from the public review were also completed and are in the process of being distributed.

300-FF-1 OPERABLE UNIT ITEMS

- ***618-4 Remediation Status.*** Drums containing depleted uranium oxide powder continue to be discovered. Operations are going well and there have been no safety incidents. Jeff Lerch (ERC) reported that 261 drums of depleted uranium waste were sent to ERDF from the 1998 (above ground) inventory. Six drums containing depleted uranium waste and 43 drums with miscellaneous contents remain onsite from the 1998 inventory. A total of 80 drums have been excavated in 2002. Of those 80, 77 have been depleted uranium oxide powder, and 3 contained depleted uranium chips and oil. Loose material consisting of yellowcake and oil saturated soil was placed in 5 other drums. Jeff Lerch (ERC) will distribute a weekly waste tracking report during excavation operations.

  Bob McLeod (DOE) noted, however, that a third layer of drums at the burial ground had not been encountered and therefore the total number of drums may be reduced by one third, accelerating the schedule.

- ***Drum Treatment Technologies.*** No changes have been made regarding this agenda item. Rich Carlson (ERC) reported that there were additional comments on the baseline technology report and that a final copy was still a few weeks out.

- ***Spill Reporting.*** The spill report requires review by Mike Goldstein (EPA).

300-FF-2 OPERABLE UNIT ITEMS

- ***618-11 Benchmarking.*** Specifics of the upcoming 618-11 Benchmarking conference call were discussed. The conference call is scheduled for Wednesday, June 12th, 2002 from 8-9 a.m. at 3350 George Washington Way. The conference call will include DOE and contractor staff from INEEL, Oak Ridge, and other DOE sites.

  Prior to the meeting, Mike Goldstein (EPA) will meet with Kevin Leary (DOE) to discuss the transition of the 618-10 and 618-11 Burial Grounds as well as discuss a path forward for the next 5 years.

- ***Outside the Fence Design.*** Outside the Fence Design is proceeding on schedule and the intermediate design is due for contractor internal review the week of May 20th, 2002. The final design will be completed by August 2002. Design for the 618-5 Burial Ground is complete and was not included in the design package. Bob McLeod (DOE) recommended that Mike Goldstein (EPA) review the design plan and aerial photos for 618-5.

- ***RDR/RAWP/SAP.*** Rich Carlson (ERC) announced that the MTCA ecological issues had been resolved, and that closure on the compositing issue was moving forward. A meeting with Ecology was to take place on May 15th, 2002. The schedule and budget for the RDR/RAWP and SAP were also discussed.

  Specific language regarding the location and design requirements for institutional controls (ICs) in the 300 Area were requested to be incorporated into the 300-FF-2 RDR/RA Work Plan. Rich Carlson (ERC) recommended including figures specifying locations of ICs. Mike Goldstein (EPA) requested a copy of the ERC comments specified in Action Item No. 2-02.

- ***Kd/Leach Study Status.*** An upcoming multi-topic meeting including discussion of the Kd/Leach study, was discussed. The meeting was scheduled for June 12th, 2002 beginning at 9:30 a.m. The meeting will begin with a discussion of groundwater monitoring, cleanup standards, the status of the O&M Plan, and how the Kd/Leach study fits into the soil remediation program. The discussion will be followed by a laboratory tour. Afternoon discussions will include the development of a conceptual exposure model for uranium and its use for demonstrating that remedial actions are protective of groundwater.

300-FF-5 OPERABLE UNIT ITEMS

- ***300-FF-5 O&M Plan.*** Final comments on the 300-FF-5 O&M Plan have been resolved and incorporated. The official transmittal letter requires signature. The O&M plan has been approved, and pending a transmittal letter, would be distributed the week of May 13th, 2002. The SAP is scheduled for distribution the week of May 20th, 2002

  The construction of two monitoring wells at the 618-10 Burial Ground was also discussed. The wells would be constructed this fiscal year (FY02) and would need to be incorporated with the C3T Team goal. Soil-gas testing may be performed prior to well construction. Mike Goldstein (EPA) added that the addition of two monitoring wells will enhance the monitoring capabilities at the site because the current well network only monitors the crib contents and is not adequate to detect releases from the burial ground.

- ***300 Area Shoreline Study.*** This agenda item was addressed at the April meeting.

OTHER ITEMS

- Ella Coenenberg (ERC) added a comment response package to the meeting minutes. The comment response package relates to the technical expert review of the Kd/leach test program and contains an updated uranium conceptual site model "white paper" and revised Appendix B from the SAP (DOE/RL-2000-75, Rev. 2) that explains changes from the original scope of work.

- Larry Hulstrom (ERC) distributed a simplified version of the project schedule for the RDR and SAP. The schedule contains dates for issue and review, and comment periods.

- Ella Coenenberg (ERC) added a copy of the DOE approved non-radiological air evaluation report for 300-FF-1 OU remedial actions to the meeting minutes. This closes out a previous commitment.

300 Area Unit Manager Meeting Action Items Log

Action #								
[redacted]	Ted Posten Presentation on *current* Shoreline Study for April UMM	Mike Thompson	April UMM	03/19/2002	04/16/2002			Presentation given by Ted Posten
[redacted]	Ella Coenenberg will cover over Site Wide Institutional Controls Plan comments with Mike Thompson	Ella Coenenberg	Mike Thompson	04/16/2002				
[redacted]	RL and EPA need copy of Readiness Assessment Presentations for 618-4 and 618-5 Burial Grounds.	John April	Mike Goldstein Bob McLeod	04/16/2002				
[redacted]	Spill Reporting White Paper Review and Comments.	Mike Goldstein	Jeff Lerch	04/16/2002				
[redacted]	EPA Response to State of Oregon	Bryan Foley	Mike Goldstein	04/16/2002				

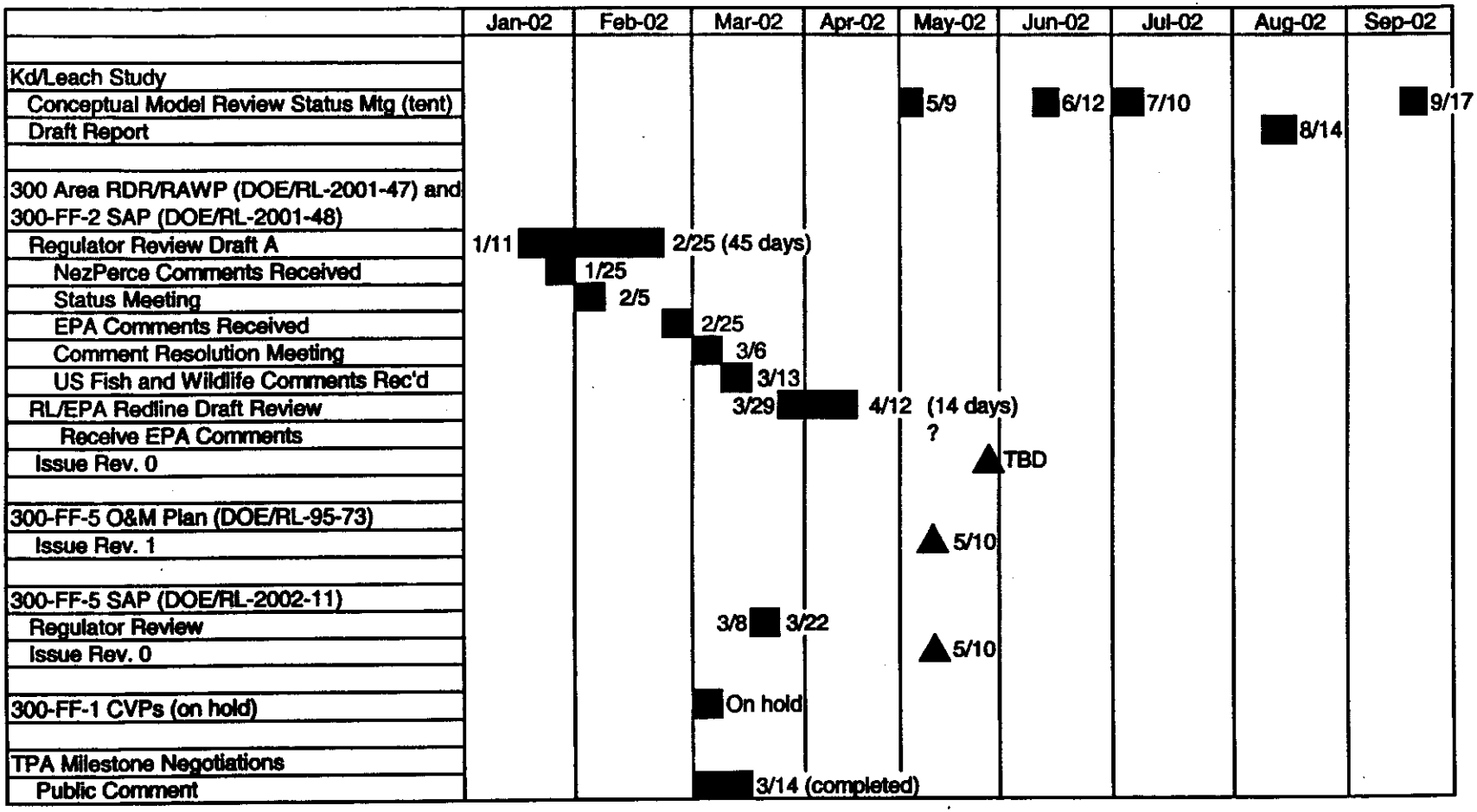
Attachment 4

300 Area Unit Manager Meeting Action Items Log

	Ted Poston (PNNL) Presentation on current 300 Area Shoreline Study for April UMM	Mike Thompson	April UMM	03/19/2002	04/16/2002			Presentation given by Ted Poston. Closed
02-01	Send draft Sitewide Institutional Controls Plan comments to RL to forward to EPA.	Ella Coenenberg	Mike Goldstein	04/16/2002				ERC provided to DOE. Ella Coenenberg (ERC) sent the draft of the comments on the Sitewide Institutional Controls Plan to John Sands (DOE), who will forward to Mike Goldstein (EPA). Rich Carlson (ERC) to do follow-up.
02	Send 618-4/5 Readiness Assessment presentations to RL to forward to EPA.	John April	Mike Goldstein Bob McLeod	04/16/2002			5/14/02	Closed. Readiness Assessment presentations for 618-4 and 618-5 Burial Grounds sent to Bob McLeod (DOE) and Mike Goldstein (EPA) via email on 5/1/2002.
	Spill Reporting White Paper requires review by Mike Goldstein (EPA).	Mike Goldstein	Jeff Lerch	04/16/2002				
	EPA Response to State of Oregon	Bryan Foley	Mike Goldstein	04/16/2002				EPA Response to State of Oregon – Bryan Foley (DOE) forwarded to Mike Goldstein (EPA); Mike Thompson (DOE) also has a groundwater related response that he will provide to Mike Goldstein (EPA).

Attachment 5

300 Area Activities for Regulator Review/Approval



Attachment 6

5/14/2002

Nonradioactive Air Emissions Evaluation for the Handling of the 618-4 and 618-5 Drums

1.0 INTRODUCTION

Remedial action (i.e., cleanup) of the 618-4 and 618-5 Burial Grounds has and will continue to uncover a large number of buried drums. The drums will be sampled, overpacked, and moved to a drum control area. Eventually the drums will be transported to a drum staging area at the Environmental Disposal Facility (ERDF). This remedial action is being conducted under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA).

The drums contain constituents that are listed in the *Washington Administrative Code* (WAC) 173-460. This evaluation provides the documentation that sampling and handling of these drums are in compliance with WAC 173-460-080 and WAC 173-400-110.

2.0 PLANNED ACTIVITIES

As previously stated the work scope includes excavating, sampling, overpacking, and transporting drums from the 618-4 and 618-5 Burial Grounds. The 618-4 Burial Ground is estimated to contain 924 (30 gallon) drums of oil coated metal tailings, fines and sludges (BHI, 2001a). There are also 260 (30 gallon) drums of oil coated metals currently being stored above ground at 618-4 (BHI, 2001b). The estimated number of drums for 618-5 was based on best engineering judgment and is assumed to be 345 (30 gallon) drums of oil coated metal tailings, fines and sludges (BHI, 2001c)

As drums are encountered during excavation, they will be placed in an overpack at the dig face if their contents appear to be leaking. Otherwise, they will be moved to a drum inspection station for sampling and overpacking. The drummed waste will subsequently be moved to a control area within the burial ground Area of Contamination, loaded onto flatbed trailers and transported to the ERDF for interim staging or disposal.

3.0 EMISSIONS INVENTORY

The constituents identified in the drums (depleted uranium chips and oil) are based on characterization results of the drums (BHI, 1998) and include metals, volatile organic compounds, and polychlorinated biphenyl (PCBs) compounds. These constituents are listed in Table 1. The list identifies which constituents are considered Class A or Class B toxic air pollutants (TAPs) (under WAC 173-460). It also identifies the constituents which are considered to have the potential to volatilize under the conditions of the drums and therefore was subject to this evaluation.

Table 1. Contaminants in Drums (Depleted Uranium Chips and Oil).

Contaminants	Toxic Air Pollutant Classification [1]	Available as Inventory
Arsenic	A	No
Barium	B	No
Cadmium	A	No
Chromium	A	No
Lead	A	No
Mercury	B	Yes
Selenium	B	No
Silver	B	No
PCBs	A	Yes
2-butanone	B	Yes
Trichlorethene	A	Yes
Benzene	A	Yes
Tetrachoroethene	A	Yes

[1] A = Class A toxic air pollutants
B = Class A toxic air pollutants

The WAC 173-400-110 provides the new source review requirements for toxic air pollutant sources and identifies exemptions based on source type or threshold quantities. While new source review is not required for CERCLA related activities, the potential emissions from the handling of the drums were compared to the threshold quantities of WAC 173-400-110(5). A summary of the calculation results compared with the threshold quantities is provided in Table 2.

Table 2. Comparison of Calculated Pollutant Emissions with Threshold Levels.

Pollutant		Calculated Level, Ton/Year [1]	Threshold Level, Tons per Year (WAC 173-400-110[5][c]]
(a)	Total Suspended Particulates	None	1.25
(b)	PM 10	None	0.75
(c)	Sulfur Oxides	None	2
(d)	Nitrogen Oxides	None	2
(e)	Volatile Organic Compounds, total	4.32E-02	2
(f)	Carbon Monoxide	None	5
(g)	Lead	None	0.005
(h)	Ozone Depleting Substances	None	1
(i)	Toxic Air Pollutants	See Tables 3, 4, and 5	As specified in WAC 173-460

[1] (a) Total suspended solids: None, venting drums produce no particulates.
(b) PM 10: None, venting drums produce no particulates.
(c) SOx: Sulfur oxides are produced mainly by thermal oxidation. Drum storage does not involve a thermal process, so SOx emissions are zero.
(d) NOx: Nitrogen oxides are produced mainly by thermal oxidation. Drum storage does not involve a thermal process, so NOx emissions are zero.
(e) VOCs: Sum of volatile organic compounds shown in Tables 3, 4, and 5are summarized below.

Substance	lb/yr
Benzene	3.15E+00
PCE	3.43E+00
TCE	4.24E+01
PCBs	7.87E-03
2-butanone	3.74E+01
Sum	8.64E+01 = 4.32E-02 tons/yr

(f) Carbon monoxide: None, not a thermal process.
(g) Lead: None, lead emissions would only occur under thermal conditions or milling operations.
(h) Ozone depleting substances: None.

The WAC 173-460-040 supplements the new source review requirements of WAC 173-400-110 by adding requirements for TAPs sources. A source impact level analysis was conducted in accordance with WAC 173-460-080 for constituents identified as TAPs in WAC 173-460. Emission rates calculated for the handling of drums were compared to the small quantity emission rates (SQERs) in WAC 173-460-080(2)(e). Based on the drum inventory, the calculated emissions for these constituents were less than the SQERs (Tables 3 and 4). The nonradioactive emissions calculations and assumptions are documented in a formal calculation (BHI, 2002). The calculation of the amount of PCBs lost to air exchange is based on the conservative approach of using the vapor pressure of the pure substance and a container of pure material (100 percent PCBs) (BHI, 2002). The emission rate for PCBs using vapor pressure is presented in Table 5.

Table 3. Emission Rates of Class A TAPs with SQERs.

Substance	CAS* Number	Concentration, mg/L	Volume of Waste, Liters/yr	Inventory, mg/yr	Calculated Emission Rate, Pounds per Year	ASIL, micrograms/ cubic meter, 24 hour average (WAC 173-460-160)	SQERs for Class A TAPs, pounds per year (WAC 173-460-080[2][e])
Benzene	71-43-2	14.6	97,856	1.43E+06	3.15	0.12	20
PCE	127-18-4	15.9	97,856	1.56E+06	3.43	1.1	500
TCE	79-01-6	196.9	97,856	1.93E+07	42.44	0.59	50

Table 4. Emission Rates of Class B TAPs with SQERs.

Substance	CAS Number	Solids Inventory, mg/yr	Oil Inventory, mg/yr	Total Inventory, mg/yr	Calculated Emission Rate, Pounds Per Year	Calculated Emission Rate, Pounds per Hour	ASIL, micrograms /cubic meter, 24 hour average (WAC 173-460-160)	SQERs for Class B TAPs, pounds per year (WAC 173-460-080[2][e])	SQERs for Class B TAPs, pounds per hour (WAC 173-460-080[2][e])
2-butanone	78-93-3	0	1.70E+07	1.70E+07	37.37	4.27E-03	1000	43,748	5.0
Mercury	7439-97-6	6.16E+04	2.85E+04	9.01E+04	0.20	2.27E-05	0.17	175	0.02

Table 5. Emission Rate for PCB using Vapor Pressure

Substance	CAS Number	Molecular Weight*, g/gmol	Vapor Pressure*, mmHg	Calculated Emission Rate, lb/yr	SQERs for Class A TAPs, pounds per year (WAC 173-460-080[2][e])
PCB	1336-36-3	3.26E+02	6.00E-05	7.87E-03	5.00E-01

* The vapor pressure and molecular weight for PCBs reference is NIOSH 1997.

4.0 EMISSION CONTROLS

The drum handling activities will be conducted utilizing as low as reasonably achievable practices during the activities. These practices include isolating the drums prior to sampling, ensuring the drums are stabilized (oil added to the drums to cover the uranium metal) and safety precautions such as use of grounding equipment and non-sparking tools and monitoring drum gases and temperatures.

The drums will be staged at the ERDF in an access restricted area separate from the ongoing disposal activities. The staging area will be managed as a Corrective Action Management Unit, allowing waste to be staged while it awaits treatment prior to disposal. (Treatment of the staged drums is not within this air emission evaluation.) Inspections of the drums will be performed according the drum inspection plan developed for this staging area.

5.0 CONCLUSION

This evaluation provides the documentation that sampling and handling of these drums are in compliance with WAC 172-460-080 and WAC 173-400-110. The potential emissions from the handling of the drums were determined to be below the threshold quantities established in the regulations. Therefore, no special controls were established for these activities.

6.0 REFERENCES

BHI 1998, *300-FF-1 Operable Unit, 618-4 Burial Ground Drummed Waste Characterization Summary*, CCN 062251, Bechtel Hanford Inc., Richland, Washington.

BHI 2001a, *Air Emission Calculation for Removal of Contaminant Material form 618-4 and 618-5 Burial Grounds*, Calc. No. 0300X-CA-V0011, Rev. 0, Bechtel Hanford Inc., Richland, Washington.

BHI 2001b. *300-FF-1 Operable Unit Authorization Basis for 618-4 Burial Ground*, MOC-2001-0011, Rev. 0, Bechtel Hanford Inc., Richland Washington.

BHI 2001c, *Dose Calculation for Remediation of the 618-5 Burial Ground*, Calc. No. 0300X-CA-N0006, Rev. 1, Bechtel Hanford Inc., Richland, Washington.

BHI 2002, *Toxic Air Pollutant Emissions from 618-4 and 618-5 Drums Containing Uranium Chips and Oil*, Calc. No.0600X-CA-V0021, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

Concurrence:

Robert McLeod 4-23-02

R. G. McLeod — Date
U.S. Department of Energy,
Richland Operations Office

M. I. Goldstein 4/11/02

M. I. Goldstein — Date
Environmental Protection Agency
Richland, Washington

"Lijek, Stephen"
<slij461@ECY.WA.GOV
>

04/11/2002 08:19 AM

To: Mike Goldstein/R10/USEPA/US@EPA
cc: "Hensley, Jerry" <jhen461@ECY.WA.GOV>, "Price, John" <Jpri461@ECY.WA.GOV>
Subject: FW: 618-4, -5 Air Emissions Evaluation

EPA requests concurrence from Ecology regarding drum management (i.e., drum removal, handling, and sampling) during remediation of the 618-4, -5 Burial Grounds. This letter grants and clarifies Ecology's concurrence with the actions as described in an electronic memorandum, Mr. Goldstein to Mr. Hensley, Nonradioactive Air Emissions Evaluation for the Handling of the 618-4 and 618-5 Drums, transmitted to Ecology on or around 4/8/02.

I agree sampling and drum handling during remediation of the 618-4 and 618-5 Burial Grounds will be in compliance with WAC 172-460-080 and WAC 173-400-110 if conducted in a manner as outlined in the electronic memorandum. The emissions resulting from sampling, overpacking, and other drum management activities should be low, even when using very high release fractions. This concurrence is limited to drum management and sampling, and to the contaminants listed, and does not include emissions that might result from exposed contaminated soil (except as necessary to facilitate sampling) and/or unforeseen waste constituents.

Since this is a CERCLA action, and the waste is apparently not fully characterized, it is possible other hazardous substances might be discovered and/or contaminated soil found. No special controls are necessary, except those described in the letter, which includes monitoring for air toxics and hazardous substances. The letter indicates ALARA practices will be used for drum handling and sampling, and ALARA applies to chemical and radiation hazards. I also assume contingency plans have been prepared for these activities.

The letter was well prepared and fairly complete, although lacking in detail on how sampling will occur. However, I agree the emissions estimate bounds most routine actions expected to result from this activity. If you have questions, or need more information please call me at 736-3095.

McLeod, Robert G (Bob)

From: Larsen, Astrid P
Sent: Monday, April 15, 2002 2:24
To: McLeod, Robert G (Bob)
Subject: RE: Air Evaluation

I have no issues or comments
-----Original Message-----
From: McLeod, Robert G (Bob)
Sent: Monday, April 15, 2002 12:06 PM
To: Larsen, Astrid P; Williamson, Barbara D
Subject: FW: Air Evaluation
Importance: High

Air Evaluation: EPA has approved with review from Ecology.
Please let me know if you have any issues or comments.

Thanks, Bob

-----Original Message-----
From: Coenenberg, Ella T
Sent: Monday, April 15, 2002 11:51 AM
To: McLeod, Robert G (Bob)
Subject: RE: Air Evaluation

Its a Monday...

> -----Original Message-----
> **From:** McLeod, Robert G (Bob)
> **Sent:** Monday, April 15, 2002 10:30 AM
> **To:** Coenenberg, Ella T
> **Subject:** RE: Air Evaluation
>
> attachment? :)
>
> -----Original Message-----
> **From:** Coenenberg, Ella T
> **Sent:** Monday, April 15, 2002 10:26 AM
> **To:** McLeod, Robert G (Bob); Larsen, Astrid P
> **Cc:** Roeck, Frederick V; Woolard, Joan G; April, John G; Lerch, Jeffrey A
> **Subject:** RE: Air Evaluation
>
> All:
>
> Per Bob's request, attached is the Nonrad Air Evaluation that includes the "conclusion" section. This was sent via an email to Bob McLeod, Mike Goldstein, John April, and Jeff Lerch on April 4th by Patty Krueger.
>
> It was recommended that a conclusion be added which states:
> "This evaluation provides the documentation that sampling and handling of these drums are in compliance with WAC 172-460-080 and WAC 173-400-110. The potential emissions from the handling of the drums were determined to be below the threshold quantities established in the

regulations. Therefore, no special controls were established for these activities."

Sorry to confuse all.

Ella

-----Original Message-----
From: Woolard, Joan G
Sent: Monday, April 15, 2002 9:06 AM
To: Coenenberg, Ella T
Cc: Roeck, Frederick V
Subject: FW: Air Evaluation
Importance: High

Ella,

Do you understand what Bob is talking about? Please let me know.

Joan
-----Original Message-----
From: McLeod, Robert G (Bob)
Sent: Friday, April 12, 2002 11:17 AM
To: Woolard, Joan G; April, John G
Subject: Air Evaluation
Importance: High

Joan, the electronic version that was sent to myself and that I forwarded to Astrid did not have a conclusion. The version signed by EPA did. Were any other changes made besides adding a conclusion? Please send an electronic version that has all changes incorporated. Thanks, Bob

618-4 BURIAL GROUND PIN SUMMARY - 2002

EXCAVATION SUMMARY

DATE	EXCAVATED DRUMS			PROJECT DRUMMED WASTE			OTHER	TOTALS
	chips/oil	oxide	other	chips/oil	oxide	other		
5/2/02		1						1
5/3/02		7						7
5/6/02		11						11
5/702		5			2			7
5/9/02	1	15						16
5/10/02		25				2		27
5/13/02	2	13				1		16
								0
Totals	*3*	*77*	*0*	*0*	*2*	*3*		*85*

SHIPMENT SUMMARY

DATE	EXCAVATED DRUMS			PROJECT DRUMMED WASTE			OTHER	TOTALS
	chips/oil	oxide	other	chips/oil	oxide	other		
								0
								0
								0
								0
								0
								0
								0
								0
Totals	*0*	*0*	*0*	*0*	*0*	*0*		*0*

CURRENT INVENTORY SUMMARY

DATE	EXCAVATED DRUMS			PROJECT DRUMMED WASTE			OTHER	TOTALS
	chips/oil	oxide	other	chips/oil	oxide	other		
5/13/02	3	77	0	0	2	3		85

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COUNT	PIN	DATE	DESCRIPTION	WASTE STREAM	STAGING INFO	SAMPLE INFO					DISPOSITION		
						Date	RCF ID	Lab ID	Tests	Comments	Description	Facility	Ship Date
1	300A-02-0069	5/2/02	55-gal galv drum w/cam lever and 30-gal inner drum that contains black, fine powder. Marked 600344 on top. 1.5 mR/hr contact dose. 990 lbs. Fill level 28".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/2/02	n/a	B14JL4	TCLP metals				
2	300A-02-0071	5/3/02	55-gal drum w/cam lever and 30-gal inner drum that contains black, fine powder. <0.5 mR/hr contact. 1044 lbs. Fill level 27".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/3/02	n/a	B14JL5	TCLP metals				
3	300A-02-0072	5/3/02	55-gal drum w/ 30-gal inner drum that contains black, fine powder. Marked 600214 on side. <0.5 mR/hr contact. 1096 lbs. Fill level 26".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/3/02	n/a	B14JL6	TCLP metals				
4	300A-02-0073	5/3/02	55-gal drum w/cam lever and 30-gal inner drum that contains black, fine powder. Marked 182 on top and 60038364 on side. <0.5 mR/hr contact. 675 lbs. Fill level 23".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/3/02	n/a	B14JL7	TCLP metals				
5	300A-02-0074	5/3/02	55-gal drum w/ 30-gal inner drum that contains black, fine powder. <0.5 mR/hr contact. 689 lbs. Fill level 7" from top.	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/3/02	n/a	B14JL8	TCLP metals				
6	300A-02-0075	5/3/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 60033926126 on top. <0.5 mR/hr contact. 935 lbs. Fill level 24".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/3/02	n/a	B14JL9	TCLP metals				
7	300A-02-0076	5/3/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 600333 on side. 0.8 mR/hr contact. 745 lbs. Fill level 23".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/6/02	n/a	B14JM0	TCLP metals				
8	300A-02-0077	5/3/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 600329 and 870 on side. 1.8 mR/hr contact. 875 lbs. Fill level 26".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/6/02	n/a	B14JM1	TCLP metals				
9	300A-02-0078	5/6/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 1.9 mR/hr contact. 1128 lbs. Fill level 27".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/6/02	n/a	B14JM2	TCLP metals				
10	300A-02-0079	5/6/02	30-gal drum removed from deteriorated 55-gal drum w/cam lever. Marked D-43, 600353, Tare 21.0, Gross 513.5, and Net 492.5 on side. 2.5 mR/hr contact. 1156 lbs. Contains black packed/crusted powder. Fill level 28".	DU oxide	30-gal drum/contents put into new 55-gal steel overpack and set aside in control area. Pierced 5/8/02. Original 55-gal drum (empty) crushed.	5/8/02	B14JM3	B14JM3	total activity, TCLP metals				
11	300A-02-0080	5/6/02	30-gal drum removed from deteriorated 55-gal drum w/cam lever. Contains black powder. Marked 610103, Tare 14, Gross 219, and Net 205 on side. 2.5 mR/hr contact. 495 lbs. Fill level 13".	DU oxide	30-gal drum/contents put into new 55-gal steel overpack and set aside in control area. Original 55-gal drum (empty) crushed.	5/6/02	n/a	B14JM4	TCLP metals				
12	300A-02-0081	5/6/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 780067 and 715 on side. 695 lbs. 2.5 mR/hr contact. Fill level 27".	DU oxide	30-gal drum/contents put into new 55-gal steel overpack and set aside in control area. Original 55-gal drum (empty) crushed.	5/6/02	n/a	B14JM5	TCLP metals				
13	300A-02-0082	5/6/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 850 lbs. 2.5 mR/hr contact. Fill level 26".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/6/02	n/a	B14JM6	TCLP metals				
14	300A-02-0083	5/6/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 715 lbs. 2.5 mR/hr contact. Fill level 25".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/6/02	n/a	B14JM7	TCLP metals				

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15	300A-02-0084	5/6/02	55-gal drum w/cam lever and 30-gal inner drum that contains hard-packed black material (1/8"). 865 lbs. 3 mR/hr contact. Fill level 23".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/6/02	n/a	B14JM8	TCLP metals				
16	300A-02-0085	5/6/02	55-gal drum w/cam lever and 30-gal inner drum that contains fine black powder. 890 lbs. 3 mR/hr contact. Fill level 25".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/6/02	n/a	B14JM9	TCLP metals				
17	300A-02-0086	5/6/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 885 lbs. 3 mR/hr contact. Fill level 27".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/6/02	n/a	B14JN0	TCLP metals				
18	300A-02-0087	5/6/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 775 lbs. 3 mR/hr contact. Fill level 25".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/6/02	n/a	B14JN1	TCLP metals				
19	300A-02-0088	5/6/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 1015 lbs. 3 mR/hr contact. Fill level 26".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/6/02	n/a	B14JN2	TCLP metals				
20	300A-02-0099	5/7/02	Loose yellow cake material discovered at dig face in area of 55-gal drums. Evidence of deteriorated 55-gal drum nearby.	DU oxide	Loose material hand shoveled into new 55-gal drum and set aside in control area. 308 lbs.	5/7/02	B14JN3	B14JN3	total activity, TCLP metals	Field pH 6.			
21	300A-02-0100	5/7/02	Loose yellow cake material discovered at dig face in area of 55-gal drums. Evidence of deteriorated 55-gal drum nearby.	DU oxide	Loose material hand shoveled into new 55-gal drum and set aside in control area. 866 lbs.	5/7/02	B14JN3	B14JN3	total activity, TCLP metals	Field pH 6.			
22	300A-02-0101	5/7/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 0527676 and "excess" on side of drum. 830 lbs. 1.5 mR/hr contact. Fill level 27".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/7/02	n/a	B14JN4	TCLP metals				
23	300A-02-0102	5/7/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 655 lbs. 1.5 mR/hr contact. Fill level 25".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/7/02	n/a	B14JN5	TCLP metals				
24	300A-02-0103	5/7/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 780068 on side of drum. 737 lbs. 1.5 mR/hr contact. Fill level 25".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/7/02	n/a	B14JN6	TCLP metals				
25	300A-02-0104	5/7/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 1118 lbs. 1.8 mR/hr contact. Fill level 28".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/7/02	n/a	B14JN7	TCLP metals				
26	300A-02-0105	5/7/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 700 lbs. 1.8 mR/hr contact. Fill level 28".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/7/02	n/a	B14JN8	TCLP metals				
27	300A-02-0106	5/9/02	55-gal drum w/cam lever and 30-gal inner drum that contains light tan powder. Marked 770051 and #257 on side. 259 lbs. <0.5mR/hr contact. Fill level 17".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/9/02	n/a	B14K66	TCLP metals				
28	300A-02-0107	5/9/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 6003??6 and 490# on side. 497 lbs. 1.5 mR/hr contact. Fill level 28".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/9/02	n/a	B14K67	TCLP metals				
29	300A-02-0108	5/9/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 780057 on side. 842 lbs. 1.5 mR/hr contact. Fill level 29" from top.	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/9/02	n/a	B14K68	TCLP metals				

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30	300A-02-0109	5/9/02	55-gal drum w/cam lever (rusted lid) and 30-gal inner drum that contains black powder. Marked 380060 on side. 680 lbs. 1.5 mR/hr contact. Fill level 28".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/9/02	n/a	B14K69	TCLP metals				
31	300A-02-0110	5/9/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 1192 lbs. 2.2 mR/hr contact. Fill level 29".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/9/02	n/a	B14K70	TCLP metals				
32	300A-02-0112	5/9/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked ?00379 and #691 on side. 706 lbs. 2.8 mR/hr contact. Fill level 20".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/9/02	n/a	B14K71	TCLP metals				
33	300A-02-0113	5/9/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 70050 and #651 on side. 655 lbs. 3.8 mR/hr contact. Fill level 27".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/9/02	n/a	B14K72	TCLP metals				
34	300A-02-0114	5/9/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked ??7004 and #602 on side. 600 lbs. 2.4 mR/hr contact. Fill level 20".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/9/02	n/a	B14K73	TCLP metals				
35	300A-02-0115	5/9/02	30-gal drum that contains black powder. Marked 600368 on top. 995 lbs. 2.6 mR/hr contact. Fill level 26".	DU oxide	Original drum/contents put into new 55-gal steel overpack and set aside in control area.	5/9/02	n/a	B14K74	TCLP metals				
36	300A-02-0116	5/9/02	30-gal drum that contains black powder. Marked 600318, Tare 20.25, Gross 510.60, and Net 490.35 on side. 1140 lbs. 2.6 mR/hr contact. Fill level 28".	DU oxide	Original drum/contents put into new 55-gal steel overpack and set aside in control area.	5/9/02	n/a	B14K75	TCLP metals				
37	300A-02-0117	5/9/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 600300 on side. 930 lbs. 2.4 mR/hr contact. Fill level 26".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/9/02	n/a	B14K76	TCLP metals				
38	300A-02-0118	5/9/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked ??0095 on side. 873 lbs. 2.0 mR/hr contact. Fill level 27".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K77	TCLP metals				
39	300A-02-0119	5/9/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 610060 and #713 on side. 746 lbs. 2.6 mR/hr contact. Fill level 25".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K78	TCLP metals				
40	300A-02-0120	5/9/02	[illegible]	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K79	TCLP metals				
41	300A-02-0121	5/9/02	55-gal drum (rusted on top) w/cam lever and 30-gal inner drum that contains black powder. Marked 410095 on side. 870 lbs. 1.8 mR/hr contact. Fill level 21".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K80	TCLP metals				
42	300A-02-0122	5/9/02	Partially crushed 30-gal w/cam lever that contains oil and exposed turnings covered with a yellowish coating. 430 lbs. 1 mR/hr contact. Fill levels 19" (chips) and <19" (oil).	chips/oil	Original drum/contents put into new 55-gal inside new 85-gal steel overpack. Mineral oil added to 30-gal and 55-gal drums, 27" fill level. Set aside in control area.								
43	300A-02-0123	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 610066 on top. 876 lbs. 2.4 mR/hr contact. Fill level 26".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K81	TCLP metals				

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44	300A-02-0124	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 600352 and #893 on top. 895 lbs. 1.5 mR/hr contact. Fill level 24".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K82	TCLP metals				
45	300A-02-0125	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 600375, Tare 41.5, Gross 400.4, and Net 358.9 on side. 894 lbs. 2.6 mR/hr contact. Fill level 24".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K83	TCLP metals				
46	300A-02-0126	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 780071, Tare 22, Gross 295, and Net 273 on side. 725 lbs. 2.6 mR/hr contact. Fill level 27".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K84	TCLP metals				
47	300A-02-0127	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 610771 and #631 on side. 637 lbs. 2.5 mR/hr contact. Fill level 25".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K85	TCLP metals				
48	300A-02-0128	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 600807 and #979 on side. 445 lbs. 2.5 mR/hr contact. Fill level 27".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K86	TCLP metals				
49	300A-02-0129	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 600319 and #809 on side. 837 lbs. 3.0 mR/hr contact. Fill level 19".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K87	TCLP metals				
50	300A-02-0130	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 600341 and #1122 on side. 1125 lbs. 2.5 mR/hr contact. Fill level 28".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K88	TCLP metals				
51	300A-02-0131	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 600325 and #1001 on side. 1090 lbs. 3.2 mR/hr contact. Fill level 28".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K89	TCLP metals				
52	300A-02-0132	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 600372 and #895 on side. 890 lbs. 2.2 mR/hr contact. Fill level 28".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K90	TCLP metals				
53	300A-02-0133	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked #809 on side. 824 lbs. 2.5 mR/hr contact. Fill level 21".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K91	TCLP metals				
54	300A-02-0134	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 835 lbs. 2.5 mR/hr contact. Fill level 25".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K92	TCLP metals				
55	300A-02-0135	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 600370 and 968 on top. 985 lbs. 3.0 mR/hr contact. Fill level 26".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K93	TCLP metals				
56	300A-02-0136	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 600368 and 1267 on top. 1285 lbs. 2.5 mR/hr contact. Fill level 27".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K94	TCLP metals				
57	300A-02-0137	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 600317 and 912 on top. 945 lbs. 2.4 mR/hr contact. Fill level 29".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K95	TCLP metals				

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58	300A-02-0138	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 60095? and 895 on top. 902 lbs. 2.7 mR/hr contact. Fill level 28".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K96	TCLP metals				
59	300A-02-0139	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 60056 and 835 on top. 962 lbs. 2.9 mR/hr contact. Fill level 26".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K97	TCLP metals				
60	300A-02-0140	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 60094? on top. 782 lbs. 2.1 mR/hr contact. Fill level 21".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K98	TCLP metals				
61	300A-02-0141	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 600??? on top. 883 lbs. 2.5 mR/hr contact. Fill level 29".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14K99	TCLP metals				
62	300A-02-0142	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 897 lbs. 2.9 mR/hr contact. Fill level 25".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/10/02	n/a	B14KB0	TCLP metals				
63	300A-02-0143	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 584 lbs. 2.5 mR/hr contact. Fill level 22".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	B14KB1	TCLP metals				
64	300A-02-0144	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 929 lbs. 3.1 mR/hr contact. Fill level 30".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	B14KB2	TCLP metals				
65	300A-02-0145	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 600334 and 1150 on top. 841 lbs. 2.0 mR/hr contact. Fill level 27".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	B14KB3	TCLP metals				
66	300A-02-0146	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 727 lbs. 2.3 mR/hr contact. Fill level 25".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	B14KB4	TCLP metals				
67	300A-02-0147	5/10/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. Marked 600311 and #937 on top. 709 lbs. 2.3 mR/hr contact. Fill level 26".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	B14KB5	TCLP metals				
68	300A-02-0148	5/13/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 536 lbs. 1.5 mR/hr contact. Fill level 16".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	B14KB6	TCLP metals				
69	300A-02-0149	5/13/02	55-gal drum that contains fine black powder and some small chips immersed in very thick oil (~90 wt). 335 lbs. 0.5 mR/hr contact. Fill levels 9" (chips) and 18" (oil).	chips/oil	Original drum/contents put into new 85-gal inside new 110-gal steel overpack. Mineral oil added to 85-gal drum (10" fill level). Set aside in control area.								
70	300A-02-0150	5/13/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder with a few fine metal slivers. 754 lbs. 2.0 mR/hr contact. Fill level 28".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	B14KB8	TCLP metals				
71	300A-02-0151	5/13/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 720 lbs. 2.7 mR/hr contact. Fill level 26".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	B14KB9	TCLP metals				

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COUNT	PIN	DATE	DESCRIPTION	WASTE STREAM	STAGING INFO	SAMPLE INFO					DISPOSITION		
						Date	RCF ID	Lab ID	Tests	Comments	Description	Facility	Ship Date
72	300A-02-0152	5/13/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 680 lbs. 1.4 mR/hr contact. Fill level 25".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	B14KC0	TCLP metals				
73	300A-02-0153	5/10/02	Oil soaked soil surrounding 300A-02-0122. <0.5 mR/hr contact.	other	Oil soaked soil put into 55-gal drum and set aside in anomalous staging area. 224 lbs.								
74	300A-02-0154	5/10/02	Oil soaked soil surrounding 300A-02-0122. <0.5 mR/hr contact.	other	Oil soaked soil put into 55-gal drum and set aside in anomalous staging area. 622 lbs.								
75	300A-02-0155	5/13/02	55-gal drum w/cam lever and very rusted 30-gal inner drum that contains yellow cake material. 295 lbs. 1.1 mR/hr contact. Fill level 15".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	B14KC1	TCLP metals				
76	300A-02-0156	5/13/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 760 lbs. 1.7 mR/hr contact. Fill level 26".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	B14KC2	TCLP metals				
77	300A-02-0157	5/13/02	55-gal drum w/cam lever and 30-gal inner drum that contains black/grey powder. 727 lbs. 2.0 mR/hr contact. Fill level 24".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	B14KC3	TCLP metals				
78	300A-02-0158	5/13/02	55-gal drum that contains fine black powder and some small chips immersed in very thick oil (~90 wt). 500 lbs. 1.3 mR/hr contact. Fill levels 19" (chips) and 25" (oil).	chips/oil	Original drum/contents put into new 85-gal inside new 110-gal steel overpack. Mineral oil added to 85-gal drum (~20" fill level). Set aside in control area.								
79	300A-02-0159	5/13/02	30-gal drum marked ??2471 removed from deteriorated 55-gal drum. Contains damp yellow cake material with irregular clumps. 382 lbs. 1.2 mR/hr contact. Fill level 28".	DU oxide	Original drum/contents put into new 55-gal steel overpack and set aside in control area.	5/13/02	n/a	[redacted]	TCLP metals				
80	300A-02-0160	5/13/02	~30 ml test tube w/cork stopper. Filled w/clear yellow liquid. <0.5 mR/hr contact.	other	Put into 1L jar with dry sand for padding and set asside in anomalous staging area.								
81	300A-02-0161	5/13/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 740 lbs. 1.2 mR/hr contact. Fill level 25".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	[redacted]	TCLP metals				
82	300A-02-0162	5/13/02	55-gal drum w/rusted cam lever lid and very rusted 30-gal inner drum that contains yellow cake material. 454 lbs. 1.4 mR/hr contact. Fill level 27".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	B14KC6	TCLP metals				
83	300A-02-0163	5/13/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder. 482 lbs. 1.2 mR/hr contact. Fill level 14".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	B14KC7	TCLP metals				
84	300A-02-0164	5/13/02	55-gal drum w/missing lid and 30-gal inner drum covered with rocks/soil that contains black powder. 917 lbs. 1.5 mR/hr contact. Fill level 24".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	B14KC8	TCLP metals				
85	300A-02-0165	5/13/02	55-gal drum w/cam lever and 30-gal inner drum that contains black powder with some metal widings. 436 lbs. 1.0 mR/hr contact. Fill level 27".	DU oxide	Original drum/contents put into new 85-gal steel overpack and set aside in control area.	5/13/02	n/a	B14KC9	TCLP metals				

Comment Response Package
To Technical Expert Review
On the Preliminary Results from the Kd/Leach Study of 2001
and the Draft Uranium Conceptual Site Model White Paper

In this attached package you will find the responses to the following:

1. Comments on Draft 300 Area Uranium White Paper, Generic Site Model PowerPoint Presentations, and "kdstatusoct01 draftrev1" PowerPoint Presentation
2. Comments on 300 Area Uranium Leach Adsorption Study for BHI FY01 Progress Report
3. Comments on FY02 Proposed Work
4. Path Forward Recommendation

Responses to
Comments on Draft 300 Area Uranium White Paper, Generic Site Model PowerPoint Presentation, and "kdstatusoct01draftrev1" PowerPoint Presentation

From
Charles R. Bryan
Sandia National Labs
4100 National Parks Highway
Carlsbad, NM 88220
November 29, 2001

General Comment:

I am not sure that the conceptual model presented in this paper, and in the PowerPoint Presentation, is valid. As noted in the paper, the Kd describes the partitioning of the contaminant between the liquid and solid phases *at equilibrium*. It is not possible to break out sorption and desorption as separate processes. The Kd does not describe the process, or differentiate between them. It merely describes the partitioning between the solid and liquid phases.

What the computer code does, is, at each step, calculate the total amount of uranium present in each volume element, and then use the Kd to partition that uranium (U) between the two phases. Thus, it is inaccurate to say that a desorption Kd will be used for the contaminated vadose zone, and a sorption Kd for the uncontaminated vadose zone and the saturated zone. It is more accurate to say that the laboratory results indicate that different Kd's are appropriate for the contaminated and uncomtaminated zones. The Kd *determined from the desorption experiments* will be used for the contaminated zone, and the Kd *determined from the sorption experiments* for the uncontaminated zones. Both the white paper and the generic site model PowerPoint presentation should be modified to make it clear that this is the case. Also, the justification for using the different Kd's must be more rigorously defined.

Also, in the White paper, it states that the "adsorption Kd" will be used in the saturated zone, while the final slide of the generic site model shows the "desorption Kd" being used for this region.

The plan proposed here for applying the FY01 results to the area 300 RESRAD modeling does not accurately describe the mechanisms of transport. The experimental work shows that there is a relatively small fraction of uranium (< several percent) that is very easily leached from the soil. The remaining material is very tightly bound. This is not amenable to a simple Kd model. Using a desorption Kd that is calculated by using the maximum concentration in the leach solutions, and the total uranium present in the soil, will yield a relatively large Kd—but using this as described in the White Paper is incredibly conservative. If contaminants are being leached from a soil and the Kd is large, then most of the uranium is in the solid phase, and the concentration in solution drops only very slowly with time. If the initial solution concentration is assumed to be high (as in the leach column experiments), then it will remain high for a very long time.

I have included an illustration of this in Figure 1. Two conceptual models are shown here. In the first model, 5% of the uranium in the system is assumed to be highly mobile (the Kd is low, 0.1), and the other 95% is assumed to be immobile (this is similar to what the experimental data suggest). The concentration in solution drops very quickly, as the majority of the exchangeable U, at any step, is in the solution. In the second model, 100% of the uranium was involved in sorption, and a moderate Kd (7) was used (this is essentially what is being proposed for the site 300 RESRAD model). The concentration in solution in this case drops much more slowly. The only constraint on these two models is that the initial concentration in solution is the same. For the site 300 case, it would be the maximum U concentration in the leachate from Jeff Serne's column experiments. It's obvious that using a higher Kd, but assuming that more of the uranium participates in sorption, is very conservative.

I agree with Jeff Serne's interpretation of the experimental data presented in the Draft Leach and Adsorption Project Progress Report, that a few % of the uranium in the soil appears to be readily leachable, while the remainder appears to be tightly bound. Jeff also voices concerns about running static desorption experiments in FY02. As he states, since much of the uranium on the solid does not appear to participate in exchange, these experiments will yield unrealistically high Kd's.

A more complex conceptual model for the site, treating the readily leachable and tightly bound Uranium separately, may be necessary. It may be possible to quantify the amount of readily leachable U in the system, and to determine a Kd for the tightly bound uranium fraction, by continuing the column leach experiments until a steady state effluent concentration is reached. Alternatively, if mineral solubility appears to be limiting the aqueous U concentration at this point, it may be more accurate to model the contaminated soil, once the loosely bound U fraction has washed out, as a continuous source.

Response:

The draft white paper (Attachment A) was revised to reflect the more appropriate Kd process that was described above. As recommended, the proposed conceptual site model (CSM) will differentiate from the readily leachable, the more tightly bound (less leachable), and the saturated zones uranium. The basis/rationale for proposing this CSM is also provided in the draft white paper.

The PowerPoint presentations were also revised to align with the changes made to the white paper as described above.

Comment:

A sequential leach experiment, in which all the leachate is extracted and replaced with fresh after every step, may be another way of quantifying the leachable fraction of U, and, once that has been extracted, of measuring a Kd for the tightly bound fraction.

Response:

The effect of sequential leaching will be accomplished as described in the revised test plan (Appendix B) by performing batch leach tests on five contaminated sediments that have already been leached in the flow-through column tests. Batch leach tests will be performed for 150 days or until June 30, 2002, with periodic sampling of batch leachate to find out when steady-state uranium concentrations are reached. This is a much more economical test procedure column testing and will yield the same kind of quantifiable results in a shorter length of time.

Comment:

However, it is not obvious how to incorporate the easily leached fraction into a RESRAD model.

Response:

The RESRAD model allows for incorporating different Kd values for contaminated zone soils, unsaturated/uncontaminated vadose zone soils, and saturated zone soils/sediment. Separate runs of the RESRAD model will be performed for the easily leached and less-readily leached fractions of uranium in the contaminated zone to determine the uranium concentration predicted in groundwater at appropriate time frames. The results of the individual RESRAD runs for the easily leached and less-readily leached fractions of uranium will be added together to determine if the uranium MCL for groundwater (30 μg/L) is predicted to be exceeded.

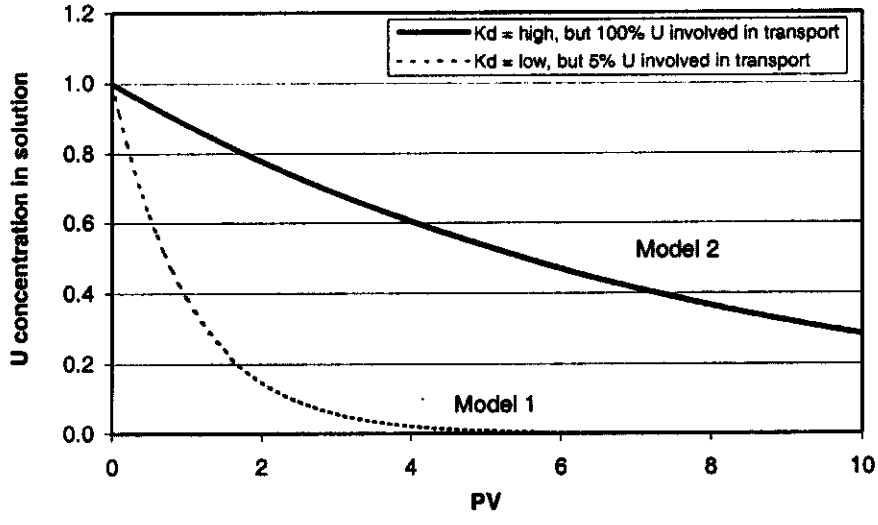

Figure 1. Uranium elution, using two different Kd models. In the first (dotted line), 5% of the total U is assumed to be mobile, and a very low Kd (0.1) is used. In the second (solid line), 100% of the U is assumed to be mobile, and a Kd of 7 is used. The initial concentration was the same in each case.

Responses to
Comments on 300 Area Uranium Leach Adsorption Study for BHI FY01 Progress Report

From
Charles R. Bryan
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November 29, 2001

General Comments:

This is a well-written document, and in general does a good job of describing the experiments and results. The data quality is excellent. The copy I reviewed was not quite complete—a figure was missing, and some data were missing from tables. I have noted where these occur.

Minor editorial changes and suggestions have been made directly in an edited version of the document sent along with this summary. A few other general suggestions are given below.

1) In many cases, acronyms are not defined upon first use (for example, EC, ICP, and IC are not defined in the first paragraph of section 1.3). Either do this, or add an acronym list to the beginning of the document.
2) Many tables are incomplete. I assume that in the final version, these will be completely filled in.

Response: Comments noted: These suggestions will be addressed in preparing the final draft that is expected in August 2002.

Specific comments:

1) Table 1.1—be consistent in the use of capitals, abbreviations, and full sentences in the "Details" section.

   Response: Comment noted: These suggestions will be addressed in preparing the final draft that is expected in August 2002.

2) Table 1.2—incomplete, missing the last two columns of data.

   Response: Comment noted: These suggestions will be addressed in preparing the final draft that is expected in August 2002.

3) Table 2.2 – incomplete, missing the EC data, and some of the pH data. The pH data from the contaminated sites would be very nice to see—are they similar to the background site? If the EC data are not available, then the references to them in the text should be removed.

Response: Comment noted: These suggestions will be addressed in preparing the final draft that is expected in August 2002. The pH data and EC data will be collected and reported in the final draft report.

4) Section 2.2.2 discusses the water extract anions and cations. The calculated porewater U concentrations in Table 2.8 greatly exceed the solubility of U at neutral pH. Is the carbonate concentration high? Is something complexing the uranyl? Are soluble uranium salts contributing to the water-extracted fraction? All of this assumes that the pH *is* neutral. It is not listed in Table 2.2 (see note 3). Alternatively, perhaps other salts are dissolving, and are competing with exchangeable U.

The same is true of the Si data presented in Table 2.6. The very high calculated pore-water Si concentrations are only possible if the pH is low. Otherwise, Si-containing phases must be dissolving.

Perhaps it would be better to leave out the calculated pore water composition data, since, as is stated in the paper, it is only really applicable under saturated conditions.

Response: Comments noted: The study will be evaluating the relationship of these parameters on mobility of uranium. The findings will be reported in the final draft report that is expected in August 2002.

5) Section 2.3, paragraph 1, on the organic carbon content of the sediments. You state that "The atypically high organic content in sample B11BY5 may be associated with the lower than expected U water leach rate from this sediment." However, the sequential leach results do not show that there is a higher fraction of the U tied up in organics in this sample. In fact, it is actually a little lower than the other two samples from this site.

Response: The statement that infers a correlation between the high organic matter content in B11BY5 and the low leach rate of uranium will be changed in the final report. It should be noted that this sample contains atypically high organic matter and the uranium leach rate is the lowest of all samples tested. The selective extraction step that dissolves organic matter does not show large releases of uranium. To date, there is no explanation as to why sample B11BY5 leaches so little uranium.

6) Table 2.10. The totals look good, and would be better if loss-on-ignition (LOI) was done on the powdered samples. The water content could be determined from that, since the C present as organics and carbonates is known, and the weight loss due to CO_2 generation can be calculated. Is LOI data available? Is it too late to include that?

Response: There is no loss-on-ignition (LOI) data at this time. The samples were oven-dried before they were submitted for analyses so that there would not be mass unaccounted for upon drying to 105°C at the analytical laboratory. It is already known that the organic carbon content of the samples is less than 1%. Therefore, there may be weight losses that occur upon drying in the analytical laboratory muffle furnace that represents more than loss of organic compounds. We are satisfied with our mass balance

that accounts for 91% to 99% of the mass of material submitted for analysis, but we will submit samples for LOI analysis if we can obtain portions of the samples that were sent to XRF. However, we will not attempt to reproduce the samples sent to XRF if we can not obtain portions of the original samples.

7) Table 2.13, on the clay composition of the clay-sized fractions, is completely blank.

Response: Comment noted. The information will be provided in the final draft report that is expected in August 2002.

8) Figure 2.1. The title is "Activity vs Grain Size," and the caption refers to "particle size," but what is actually plotted is sieve number. The conversion is given in Table 2.15, but it would be more intuitive to change the y-axis to the sieve fraction, in μm. Also, in table 2.15 it might be more accurate to describe the size range for each fraction, rather than referring to the sieve that captured it.

Response: Comment noted. These suggestions will be addressed in preparing the final draft that is expected in August 2002.

9) Also, in the discussion of Figure 2.1 and Table 2.16, it is noted that the U content does not vary monotonically with grain size/surface area, as might be expected, and that the surface area does not vary as expected with grain size. I don't think that this is at all surprising, since the sequential extraction results show that much of the uranium is incorporated in poorly crystalline Al and Fe precipitates. These are probably just as likely to be present as precipitated coatings on larger grains, or as cements, cementing fine material into clumps, as they are to be present as finely disseminated clay-sized particles. These poorly crystalline, porous, "fluffy" grain coatings would explain the anomalously high surface areas for the coarser fractions, too. For instance, quartz spheres with a minimum diameter to be captured in the #35 sieve (0.5 mm) would only have a surface area of about 0.005 m^2/g. The actual measured value for the #35 sieve fraction was 5.8 m^2/g. Either the grains are porous and have high internal porosity, or they are really rough and pitted, or they are coated with porous coatings of Fe and Al oxy-hydroxides (ferrihydrite can have surface areas of as high as several hundred m^2/g).

Response: Comment noted. These are very good ideas, and they will be incorporated into the text in the final report.

10) Figure 2.4, the XRD patterns of the clay-sized materials, is missing (as noted in the text by another reviewer).

Response: Comment noted. These suggestions will be addressed in preparing the final draft that is expected in August 2002.

11) Section 2.8 Selective extraction results—the totals are missing for Tables 2.19 through 2.24. The results of the sequential extractions are spectacular, and illustrate that the uranium is associated with the same phases in the soils in all cases. This increases the

probability that the leaching results for these sediments will be generally applicable. However, the fact that several of the samples had more uranium present than was measured in other aliquots of the same sample is disturbing, as it suggests considerable heterogeneity—is it possible that large grains of uranium minerals (or oxides after uranium metal) are present in the soil? Perhaps an SEM study could find discrete U-mineral grains...

Response: Comment noted. SEM work and TEM work is under way on many bulk samples and clay-sized fractions, respectively. So far there is little to suggest that there are discrete crystalline or amorphous uranium-enriched particles present at high enough concentrations to be readily seen by either technique. The facilities or funds are not available to perform heavy mineral separations on the bulk samples or size separates in hopes of concentrating the uranium further so that these two instruments can better detect discrete uranium-enriched particles. The particles would have to be ~5 wt% uranium to be readily detected.

12) Section 2.9 Flow-through column leach tests—These are excellent data, which suggest, as mentioned in the report, that there is a reservoir of readily-leached uranium, which comprises up to a few percent of the total. There are several interesting points:

a. Most of the readily leached fraction appears to have been removed during the several weeks of the experiment. How does this total for each column compare to the amount of uranium removed during the H_2O and competing ion solution extractions?

Response: Discussion comparing the amount of readily leached uranium in the flow-through column leach tests in Section 2.9 to the selective extraction results in Section 2.8 will be included in the final version of this report.

b) Will the experiments be continued in the coming year?

Response: The experiments were terminated in early 2002 and the sediment from the influent end of the columns was used in batch leach tests to obtain a desorption Kd value for the recalcitrant 97% of the uranium that is not readily leached.

Once the readily leached U has been removed, does a steady state condition, suggesting a solubility-limited system, evolve?

Response: This is being evaluated with a static long term batch test using the "recalcitrant" fraction from the column tests.

c. The uranium concentrations in the effluent in several cases exceed the expected solubility of uranium. Does this mean that it is complexed with something?

Response: The final report will include MINTEQ speciation calculations to evaluate if the column leachates are in fact oversaturated and what complexes might be present.

Is bicarbonate concentration high in the effluent?

Response: Bicarbonate/alkalinity data are available.

Or, were organic ligands present in the waste?

Response: A carbon analyzer will soon be available that will allow dissolved organic content to be measured before July 2002.

Also, if the experiment were run more slowly, would the uranium precipitate out?

Response: This question cannot be answered. The flow rate was slower (residence time ~7 days per pore volume) than most run times for such tests.

d) There is an inflection in most of the curves at about 3 pore volumes. Is this when the flow interruption occurred? If so, then the inflection suggests that uranium release is kinetically limited. The inflection is small in most cases, but is very large in the B11BY5 sample.

Response: The flow interruption happened much earlier.

e) Section 2.10 Scouting Adsorption Tests—the columns used in the column adsorption experiments are too small relative to the grain size of the sediments used. The columns are 2.2 cm diameter, and grains in the sediment can be as large as 0.476 cm. In general, column diameter should be 30-40 times the sediment grain size to keep fast flow paths from forming. These could bypass a significant fraction of the sediment in the column, resulting in early breakthrough. This effect may be responsible for the observed inflections in the breakthrough curves (Figure 2.11). In addition, sampling every half-pore volume is pretty sparse to try and interpret a breakthrough curve for a poorly sorbing tracer. Given the high U concentration of the initial feed, maybe smaller aliquots of the effluent could be collected, and diluted 1:10 for analysis. Given the high influent U concentration, and the low U in the uncontaminated sediments used in the experiment, the fact that the C/Co rises to values significantly greater than one is puzzling. I would question the experimental method, except that I have seen a similar pattern in at least two other U column studies (including one I carried out myself). Having said that, the consistency of the replicate column results (Figure 2.11) is impressive.

For the FY02 experiments, I would recommend that larger columns be used, and that more closely-spaced sampling be done, to better define the effluent curve.

Response: Comments noted. Agree with the final suggestions and will follow them. The scouting study was performed very quickly to get some preliminary data that could be used for preliminary predictive modeling and for discussion points with DOE and EPA.

f) Section 3.0 Conclusions – Paragraph 1. "The U concentrations do not appear to be controlled by a solubility constraint, although detailed speciation calculations and comparison of ion activity products with known solubility products for crystalline U(VI) solids have not been performed as yet. " and "It appears that the leach data represent a kinetically controlled release of U from a sparingly soluble compound, likely an amorphous U(VI) compound or co-precipitate." These two sentences seem to conflict with each other.

Response: Comment noted. The text will be revised in the final draft report after evaluating the additional data that are currently being collected.

13) The plan to use desorption Kd's derived from static experiments does not seem to be appropriate. As stated in the report, the majority of the uranium appears to be in a non-exchangeable form. If the total U remaining on the solid is used to calculate the desorption Kd, then an inappropriately high value will result. Using a steady state U concentration is also inappropriate, if all of the uranium present is assumed to belong to the same, easily leached reservoir. See my comments on the 300 Area U Draft White Paper.

Response: The draft white paper was revised to differentiate from the readily leachable, the more tightly bound (less-leachable), and the saturated zones of uranium that the Kd/leach study is indicating.

14) Final paragraph—The statement that the selective extractions indicate that the uranium in the B11BY5 sediment is in a similar form to the other sites is not really true. A large fraction of the uranium in this sample was in a highly stable form, and remained in the residual after strong acid washing. This fraction is higher than for most of the other samples.

Response: Comment noted. The text will be revised in the final draft report.

Responses to
Comments on FY02 Proposed Work
From

Charles R. Bryan
Sandia National Labs
4100 National Parks Highway
Carlsbad, NM 88220
November 29, 2001

General Comments:
In general, the proposed work scope for FY02 seems well thought out. The batch sorption and column sorption/desorption experiments are well-planned, and thorough. However, the planned batch leach tests may require modification to yield meaningful desorption Kd's.

General Response: The FY02 proposed work regarding the Kd/leach study was revised accordingly. Attachment B, the *Controlled Laboratory Test Sampling and Analysis Overview*, is the FY02 proposed work that describes the sampling and analysis activities to be conducted.

Specific comments:

1) Stage 2, Step 2.1 Batch Leach Tests—This procedure will probably give a desorption Kd that is somewhat larger than is realistic, as the FY01 work has shown that much of the uranium in the sediments is not readily exchangeable. For example, if 5 μg/ml U are in solution, and 50 μg/g are on the solid, the measured desorption Kd will be 10. However, if only 10 μg/g or U on the solid is actually exchangeable, then the real desorption Kd, for the exchangeable fraction, is 2. The Kd for the non-exchangeable fraction, however, could be much higher than the measured value. Thus, the measured Kd will, in the short term (until the readily exchangeable material is washed out of the system) be non-conservative. After that, it will be too conservative. Perhaps the results of the FY01 column leach experiments and sequential leach experiments can be used to estimate the readily exchangeable U fraction.

   Also, the samples will be sparged with air, but the P_{CO2} in equilibrium with vadose zone groundwater is often considerably higher than atmospheric. Considerable effort is going into determining the effect of bicarbonate concentration on the sorption Kd's. Is there any way to include it as a variable in the desorption Kd experiments? Does any alkalinity data exist for vadose zone groundwater at the sites?

   Response: The batch leach tests were revised. See Step 2.1, Batch Leach Tests, in Attachment B.

2) Step 2.3, Perform Flow-Through Column Adsorption-Desorption Tests. The proposed flow rate, 0.07 pore volumes per day, or 1.71 cm/day (2×10^{-5} cm/sec) is less than that suggested by Relyea's (1982) equation for a minimum column flow rate. Relyea's equation:

V_{min} (cm/sec) $\geq (1.6 \times 10^{-3})/L$

(where L is column length in cm) provides an estimate of the lower limit on column flow rate necessary to minimalize the effects of dispersion and diffusion—important if you wish to back out Kd values from the breakthrough curves. For your columns (L = 24.4 cm) Relyea's equation yields a minimum flow rate of 6.6×10^{-5} cm/sec, or 0.23 pore volumes per day.

Response: The flow-through column adsorption-desorption tests were revised. See Step 2.3 of Attachment B.

Response to
Path Forward Recommendations
From
Charles R. Bryan
Sandia National Labs
4100 National Parks Highway
Carlsbad, NM 88220
November 29, 2001

General Response: The path forward recommendation as presented below was appropriately incorporated in the revised draft white paper (Attachment A) and, additionally, the controlled Kd/leach laboratory study (Attachment B) was optimized based on the evaluation of laboratory results from work performed in 2001 and from the recommendations.

Path Forward Recommendations:

The conceptual model, as presented in the White Paper and accompanying documents, is a bit misleading. As noted in my comments on the White paper, the Kd describes the partitioning of the contaminant between the liquid and solid phases *at equilibrium*. It is not possible to break out sorption and desorption as separate processes. The Kd does not describe the process, or differentiate between them. It merely describes the partitioning between the solid and liquid phases.

What the computer code does, is, at each step, calculate the total amount of uranium present in each volume element, and the use the Kd to partition that U between the two phases. Thus, it is inaccurate to say that a desorption Kd will be used for the contaminated vadose zone, and a sorption Kd for the uncontaminated vadose zone and the saturated zone. It is more accurate to say that the laboratory results indicate that different Kd's are appropriate for the contaminated and uncomtaminated zones. The Kd *determined from the desorption experiments* will be used for the contaminated zone, and the Kd *determined from the sorption experiments* for the uncontaminated zones. Both the white paper and the generic site model Power Point presentation should be modified to make it clear that this is the case.

Also, the justification for using the different Kd's must be more rigorously defended. The plan proposed here for applying the FY01 results to the area 300 RESRAD modeling does not accurately describe the mechanisms of transport. The experimental work shows that there is a relatively small fraction of uranium (< several percent) that is very easily leached from the soil. The remaining material is very tightly bound. This is not amenable to a simple Kd model. Using a desorption Kd that is calculated by using the maximum concentration in the leach solutions, and the total uranium present in the soil, will yield a relatively large Kd—but using this as described in the White Paper is incredibly conservative. If contaminants are being leached from a soil and the Kd is large, then most of the uranium is in the solid phase, and the concentration in solution drops only very slowly with time. If the initial solution concentration is assumed to be high (as in the leach column experiments), then it will remain high for a very long time.

I have included an illustration of this in Figure 1. Two conceptual models are shown here. In the first model, 5% of the uranium in the system is assumed to be highly mobile (the Kd is low, 0.1), and the other 95% is assumed to be immobile (this is similar to what the experimental data suggest). The concentration in solution drops very quickly, as the majority of the exchangeable U, at any step, is in the solution. In the second model, 100% of the uranium was involved in sorption, and a moderate Kd (7) was used (this is essentially what is being proposed for the site 300 RESRAD model). The concentration in solution in this case drops much more slowly. The only constraint on these two models is that the initial concentration in solution is the same. For

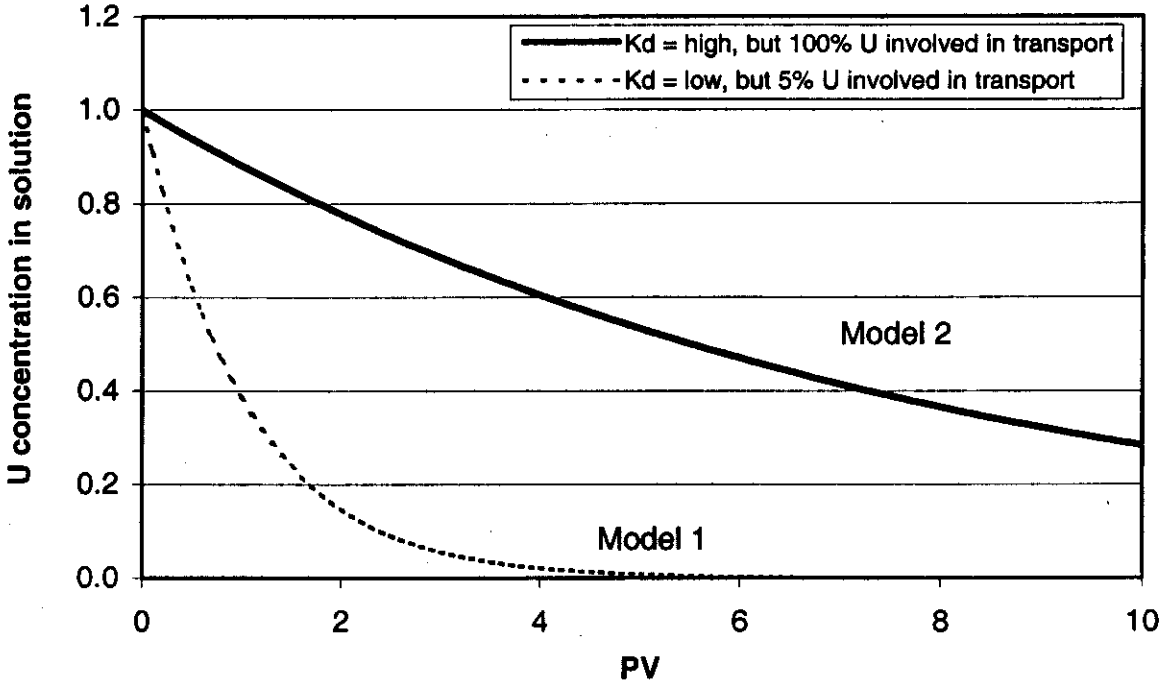


Figure 1. Uranium elution, using two different Kd models. In the first (dotted line), 5% of the total U is assumed to be mobile, and a very low Kd (0.1) is used. In the second (solid line), 100% of the U is assumed to be mobile, and a Kd of 7 is used. The initial concentration was the same in each case.

the site 300 case, it would be the maximum U concentration in the leachate from Jeff Serne's column experiments. It's obvious that using a higher Kd, but assuming that more of the uranium participates in sorption, is very conservative.

If the model is conservative, is it valid to use it for the Site 300 remediation studies? Maybe—but further work is really necessary to show that the model *is* conservative. Since the mechanisms of uranium release and transport are not known, it may be that the proposed model, based on lab experiments to date, is sensitive to variables not yet examined. Jeff's proposals to try and determine the actual form of the uranium in the soil, and to examine the effects of

groundwater pH and, especially, bicarbonate content, are important. The lab experiments were run under atmospheric conditions ($P_{CO2} = 10^{-3.5}$), while *in situ* in soils, the P_{CO2} will increase with depth, to values perhaps as high as a several tenths of an atmosphere. Have any field measurements of the CO_2 profile in the soil been made? This might be a good first start.

I am also worried that the model, as proposed, will not be able to predict the leach column results that Jeff measured. This is the only data against which the model might be calibrated, and it would over-predict the uranium concentration in the effluent. This is clear evidence that the mechanisms of transport are not understood. A regulator might be reluctant to accept a model that is demonstrably inaccurate, even if it is conservative. (There is one particular WIPP model, developed by Sandia, that overpredicted measured actinide concentrations by up to 6 orders of magnitude. The WIPP oversight groups greeted our statement that the model was acceptable because it was conservative with well-deserved derision.)

A more complex conceptual model for the site, treating the readily leachable and tightly bound Uranium separately, may be necessary. It may be possible to quantify the amount of readily leachable U in the system, and to determine a Kd for the tightly bound uranium fraction, by continuing the column leach experiments until a steady state effluent concentration is reached. Alternatively, if mineral solubility appears to be limiting the aqueous U concentration at this point, it may be more accurate to model the contaminated soil, once the loosely bound U fraction has washed out, as a continuous source.

A sequential leach experiment, in which all the leachate is extracted and replaced with fresh after every step, may be another way of quantifying the leachable fraction of U, and, once that has been extracted, of measuring a Kd for the tightly bound fraction.

However, it is not obvious how to incorporate the easily leached fraction into a RESRAD model. One possibility that might be explored would be to treat the mobile and tightly bound uranium in the contaminated sediments as two different tracers. The relatively small (few %) mobile fraction could be modeled using a low Kd (perhaps the same as the adsorption Kd used for the uncontaminated lower units), while the larger, tightly bound fraction could be modeled using either a high Kd or as a continuous source. Once the uranium exits the contaminated layer, the two fractions could be combined and treated as a single species in the lower units. This is obviously not a mechanistic model, but at least makes an effort to recognize that two different fractions of uranium, with different leaching properties, are present in the contaminated sediments.

So, to respond to the questions posed in the SOW:

1) Is the concept of using a desorption Kd for the upper vadose zone technically sound? The concept of using a different Kd for the leach and uncontaminated zones seems justifiable, and based upon the data currently available, the proposed Kd for the leach zone appears conservative. However, a better mechanistic understanding of the leaching and transport processes occurring is necessary to verify that it is really conservative. The proposed experiments, to better define the different fractions of uranium in the leach zone, and to better understand the transport processes, seem reasonable.

2) Is the concept of using a desorption Kd for the entire vadose zone technically sound? No, I don't think that this is true. The processes that sequestered the tightly bound uranium in the contaminated zone (precipitation of Fe, Al, Si hydroxides) probably are not occurring to any significant degree at the present time. It seems likely that any uranium leached out of the contaminated zone will travel with little retardation through the underlying uncontaminated zone. This is based upon the results of the adsorption experiments, which were carried out over very short time scales. The kinetically slow processes such as mineral precipitation could result in greater retardations, but there is no way to evaluate this.

3) Is the current data adequate to assign a desorption Kd to the upper vadose zone? The proposed experiments for FY02 are important to determine of potential variations in groundwater chemistry significantly affect the predicted Kd. They will also provide a better mechanistic understanding of the processes occurring in the leach zone, which may allow for development of a more robust conceptual model. They will also allow better estimation of the proportion of highly mobile uranium relative to the total, and of the leaching properties of the tightly bound fraction. These parameters will be useful in developing a more accurate conceptual model, if that becomes necessary.

4) Does the project need to understand the mechanisms of transport in order to assign a vadose zone Kd? Yes. A mechanistic understanding of the leaching and transport processes occurring is critical to evaluating the applicability and appropriateness of the laboratory-determined Kd's to long-term, field conditions.

ATTACHMENT A

300 AREA URANIUM STUDY
ISSUE SUMMARY AND PROPOSED PATH FORWARD
DECEMBER 13, 2001

DRAFT

300 AREA URANIUM STUDY
ISSUE SUMMARY AND PROPOSED PATH FORWARD
DECEMBER 13, 2001

The purpose of this white paper is to present a brief and simple overview of the Kd/Leachability concept that has been developed for the 300 Area Uranium Study. This white paper 1) provides definitions for key technical terms, 2) describes the current conceptual site model for the soil-to-groundwater pathway, 3) outlines the proposed conceptual site model for the uranium soil-to-groundwater pathway, 4) summarizes the results from the uranium leaching (desorption) and adsorption study to date, and 5) identifies proposed additional desorption and adsorption testing.

Definitions

Distribution Coefficient (Kd) – The ratio of the contaminant concentration associated with soil to the contaminant concentration in the surrounding water when the system is at equilibrium.

Desorption – The net loss of contaminant from the soil at the interface between the soil and water.

Adsorption – The net accumulation of contaminant on soil at the interface between the soil and water.

Background of the Conservative Single Kd RESRAD Site Model Approach

Numerous mechanisms affect the migration potential of contaminants in soils. To simplify mathematical modeling, the typical approach for modeling, including the RESRAD model, is to combine all the influencing factors into one Kd value.

The Kd value as currently used in the RESRAD modeling, equates to a system at equilibrium in which the soil-to-water contaminant pathway and the water-to-soil contaminant pathway are equally described by the Kd value. That is, the contaminant desorption rate from the soil into water is equal to the adsorption rate from the water onto the soil. In reality, this is rarely the case for the soil column underlying heterogeneous systems such as remediation waste sites.

Historically at Hanford, Kds have been developed using test methods where contaminated water is contacted with uncontaminated soil. This method of Kd development using adsorption-type tests generally provides a good representation of the mobility of contaminants in water infiltrating or flowing through soil. However, the Kd value is a very conservative method for representing the initial leaching or desorption step of contaminant mobility from soil affected by past waste disposal. By applying the Kd to soil affected by past waste disposal, the assumption is being made that the contaminant desorption rate from soil affected by waste disposal is equal to the water-to-soil contaminant adsorption rate. However, in reality the leaching or desorption of contaminants from soil affected by past waste disposal is generally a much slower process

than the following adsorption process that is represented by the Kd determined from adsorption experiments. The initial leaching or desorption step of contaminant mobility is effectively skipped by using the Kd determined from adsorption experiments. Once the contaminants are in solution, the Kd determined from adsorption experiments is generally representative of the continuing adsorption-desorption process of contaminant mobility. Because the initial contaminant leach or desorption step is effectively skipped by use of the single Kd determined from adsorption experiments the use of a single Kd value to describe desorption and adsorption creates a very conservative contaminant soil-to-groundwater pathway site model.

Until now, using a single conservative Kd value to describe contaminant mobility from the initial soil phase to the water phase (as well as from the water phase to the soil phase) has provided a relatively simple and conservative method for assessing remedial action goal attainment at remediation sites. As discussed, this approach is very conservative and has been successful to date primarily because the contaminants at remedial action sites have generally not been mobile.

Uranium is generally more mobile in the environment. The approach of using a single conservative Kd in the RESRAD model to describe the initial uranium transport from the soil phase to the water phase as well as from the water phase to the soil phase, is too simple and too conservative and does not adequately represent uranium mobility in vadose zone soil. Because this approach is too simple and conservative for uranium, the proposed uranium soil-to-groundwater pathway conceptual model is presented below.

Proposed Uranium RESRAD Site Model

Because the current RESRAD site model approach (used to date) is too conservative and because the uranium leach study results to date indicate that different Kds are more appropriate for describing uranium mobility from the soil phase to the water phase and from the water phase to the soil phase, a more detailed and representative site model for uranium is proposed. While this site model is more representative, it is important to note that it is still a simple and conservative site model and is not meant to precisely predict or represent uranium mobility in vadose zone soil. The purpose of the proposed site model is to present a relatively simple and conservative representation of the potential of uranium to migrate from vadose zone soil for purposes of demonstrating soil cleanup.

Soil Grain Size Considerations for the Site Model. EPA has recently expressed concerns that the proposed site model should explicitly address sampling bias effects. Sampling bias occurs because of the large gravel content of soils at the Hanford site. For samples collected for this Kd/leach study as well as for cleanup verification, the gravel content is removed and the fines are used in the experiments and laboratory analyses. Soil contamination is generally associated with the fine fraction of soil. Gravels are generally not contaminated with the possible exception of the gravel surface. Based on this and as detailed in *Radionuclide Activities in Contaminated Soils: Effects of Sampling Bias on Remediation of Coarse-Grained Soils in Hanford Formation* Report (PNNL, August 2001) the contaminant concentration based on the fine soil fraction over-represents the contaminant concentration of the entire soil fraction. For the Kd/leach study and as outlined in a *Ground Water* journal article titled *Gravel-Corrected Kd Values* (to be provided) the introduction of the gravel fraction into the Kd/leach study would lower the Kd determined

from the adsorption experiments. The Kd from the adsorption experiments would be lower, because there would be a lower proportion of fine soil adsorption sites. The Kd determined from the desorption experiments would also be lower because the ratio of the uranium concentration in the bulk soil to the uranium concentration in the leachate would be lower with gravels present. Based on the journal discussion the measured Kds would be lowered by a percentage.

In the RESRAD software, grain sizes are explicitly considered in the form of inputs for hydraulic conductivity, porosity, field capacity, and the b parameter. The real and significant effect of considering grain size in the site model would be the reduction of the contaminated zone contaminant mass. Cleanup verification samples as previously stated are collected from the fine fraction of soil, thus giving a biased high soil contaminant concentration for the actual contaminated soil mass. Again, soil contaminants are generally associated with the fine fraction. If the entire soil fraction (fines and gravels) were analyzed by the laboratory the contaminant concentration would be less than the analysis of the fines alone. The difference in concentration would be expected to be proportional to the difference in mass between the fine fraction and the total soil mass.

The approach of considering grain size in determining contaminant soil concentrations may be reasonable, however it is currently contrary to standard environmental industry practice. The *Washington State Model Toxics Control Act* also addresses this concept in WAC 173-340-740(7)(a) with the statement "Compliance with soil cleanup levels shall be based on total analyses of the soil fraction less than two millimeters in size." Because the actual contaminant concentration of the soil mass is biased upward by sampling of the fine soil fraction, the grain size consideration is another indication of the conservativeness of the site model proposed below.

Proposed Site Model. The proposed site model is discussed below and shown in the attached Figure. As previously discussed, this proposed site model is simple and conservative and has the express purpose of being used to demonstrate and assess site soil remedial actions.

Contaminated Soil Zone - Transport of uranium from uranium-contaminated soils is controlled by desorption or leaching of uranium into water infiltrating through the soil. Leach testing to date indicates that there is a readily-leachable fraction of uranium of up to 3% of the uranium mass in soil. The remaining portion of the uranium mass in soil appears to be much less leachable. Leaching or desorption of the readily leachable uranium from the contaminated zone will be modeled in RESRAD using a Kd determined from the initial desorption experiments where soil contaminated with uranium was contacted with clean water. The less leachable portion of the uranium mass will be modeled in RESRAD using a Kd determined from the desorption experiments using soil where the readily leachable fraction of uranium is no longer present. These types of leach tests will assess the ability of the uranium to move from the soil phase to the water phase.

Unsaturated Clean Soil Zone - For uranium in the water phase, the assumption is that the primary factor determining mobility is the ability of soil to adsorb uranium (transfer from the water phase to the soil phase). The adsorption of uranium in the unsaturated clean soil zone will be modeled in RESRAD using a Kd determined from the adsorption experiments where water containing uranium is contacted with clean soil. This type of

test will assess the tendency of the uranium to move from the water phase to the soil phase. Depending on the type of site, the unsaturated clean soil zone may not be included in the site-specific model. For example, for liquid waste sites the entire vadose zone may be treated as the contaminated soil zone.

Saturated Zone - Note that the site model currently being discussed will be used to assess the potential impact of uranium from the remediated site on groundwater, not the mobility of uranium currently in the groundwater or contained in the saturated zone soil. On this basis, the Kd determined from the adsorption experiments will be applied to RESRAD modeling of uranium transport in the groundwater/saturated zone.

It is also important to note that the groundwater protection assessment is made on the basis of how the infiltration water impacts groundwater as a potential drinking water source. On this basis, the saturated zone is an integral component of this conceptual model and cannot be omitted.

Uranium Kds from Testing to Date

Kd Determined from Desorption (Soil to Water) Experiments - The Kd determined from desorption experiments expresses the relationship between uranium in soil and uranium in water at equilibrium with the soil. It is affected by the type of uranium complex that is being leached from the soil. Typically, uranium may be present as varying complex oxides and carbonates depending upon process conditions, other elements in soil, and the time of exposure to water.

Values of the uranium Kd determined from desorption experiments were calculated from data by Serne, et al, described in Table 1, below, using the following relationship:

$$\text{Kd (ml/g)} = \frac{\text{(soil concentration) x (units conversion factor)}}{\text{leachate concentration}}$$

Example:

$$\text{Kd (ml/g)} = \frac{\text{(5.1 mg/kg) x } (10^3\ \mu\text{g/mg})}{(30.1\ \mu\text{g/L})} = 169\ \text{(L/kg)} = 169\ \text{(ml/g)}\ \text{[by units conversion]}$$

The Kd values presented in Table 1 are representative of the combined Kds of the readily and less leachable fractions of uranium.

Table 1. Uranium Kd Values Determined from Desorption Experiments for 300 Area Soil Samples Based on Column Leach Test Results from PNNL [a]

Soil Sample Number	Maximum Uranium Concentration in Leachate [b], (μg/L)	Uranium Soil Concentration [c] (mg/kg)	Calculated Kd, (ml/g)
B11493 (Background)	30.1 (Table 2.13)	5.1	169
B11494 (Pond Scrapings)	7238 (Table 2.14)	539.9	74.6
B11495 (Process Pond)	4968 (Table 2.15)	39.2	7.9
B11BY4 (303-K Bldg.)	41850 (Table 2.16)	562.9	13.4
B11BY5 (303-K Bldg.)	216.2 (Table 2.17)	287.4	1328
B11BY6 (303-K Bldg.)	66335 (Table 2.18)	988.8	14.9

[a] Serne, R. J., C. F. Brown, E. M. Pierce, and M. J. Lindberg: "09/24/2001 DRAFT FY01 Progress Report - 300 Area U Leach and Adsorption Project," PNNL, Richland, WA.

[b] From Tables on pages 21-30 of Serne, R. J., C. F. Brown, E. M. Pierce, and M. J. Lindberg: "09/24/2001 DRAFT FY01 Progress Report – 300 Area U Leach and Adsorption Project," PNNL, Richland, WA.

[c] From Table on page 16 of Serne, R. J., C. F. Brown, E. M. Pierce, and M. J. Lindberg: "09/24/2001 DRAFT FY01 Progress Report - 300 Area U Leach and Adsorption Project," PNNL, Richland, WA.

Kd Determined from Adsorption (Water to Soil) Experiments - The Kd determined from adsorption experiments expresses the tendency for uranium in leachate solution to adsorb on clean solids. It has no relationship to the Kd determined from the desorption experiments because the uranium on the soils used in the leach tests had been deposited from more concentrated solutions over a time period of about 30 years.

Values of the uranium Kd determined from the adsorption experiments were calculated using the following relationship based on the position of the breakthrough curve when the normalized concentration of uranium (Eff/Inf) reaches 0.5 as described in Serne, et al., footnote a, in Table 2.

$$Kd\ (ml/g) = \frac{(Inf - Eff) \times (Vol) \times (units\ conversion\ factor)}{(Eff) \times (Wt)}$$

Where: Inf is the concentration of U in the initial solution
Eff is the concentration of U in the effluent solution
Vol is the volume of solution in the test
Wt is the mass of solids in the adsorption column

Table 2. Uranium Kds Determined from Adsorption Experiment Values for 300 Area Soil Samples Based on Available Results from PNNL [a] Column Tests

Leachate Composite Sample	Influent Uranium Concentration [b] (μg/L)	Effluent Uranium Concentration [c] (μg/L)	Pore Volumes Leachate [d]	Calculated Adsorption Kd (ml/g)
B11494a (Pond Scrapings)	6250	3125	0.5	0.11
B11494b (Pond Scrapings)	6530	3265	0.5	0.11
B11BY6a (303-K Bldg.)	22800	11400	1.2	0.26
B11BY6b (303-K Bldg.)	22800	11400	1.3	0.28

[a] Serne, R. J., C. F. Brown, E. M. Pierce, and M. J. Lindberg: "09/24/2001 DRAFT FY01 Progress Report - 300 Area U Leach and Adsorption Project," PNNL, Richland, WA.

[b] From Table 2-19 on pages 36 of Serne, R. J., C. F. Brown, E. M. Pierce, and M. J. Lindberg: "09/24/2001 DRAFT FY01 Progress Report - 300 Area U Leach and Adsorption Project," PNNL, Richland, WA.

[c] From Eff / Inf = 0.5 for calculation of adsorption Kd.

[d] Estimated from Figure 2.6 on page 37 of Serne, R. J., C. F. Brown, E. M. Pierce, and M. J. Lindberg: "09/24/2001 DRAFT FY01 Progress Report - 300 Area U Leach and Adsorption Project," PNNL, Richland, WA.

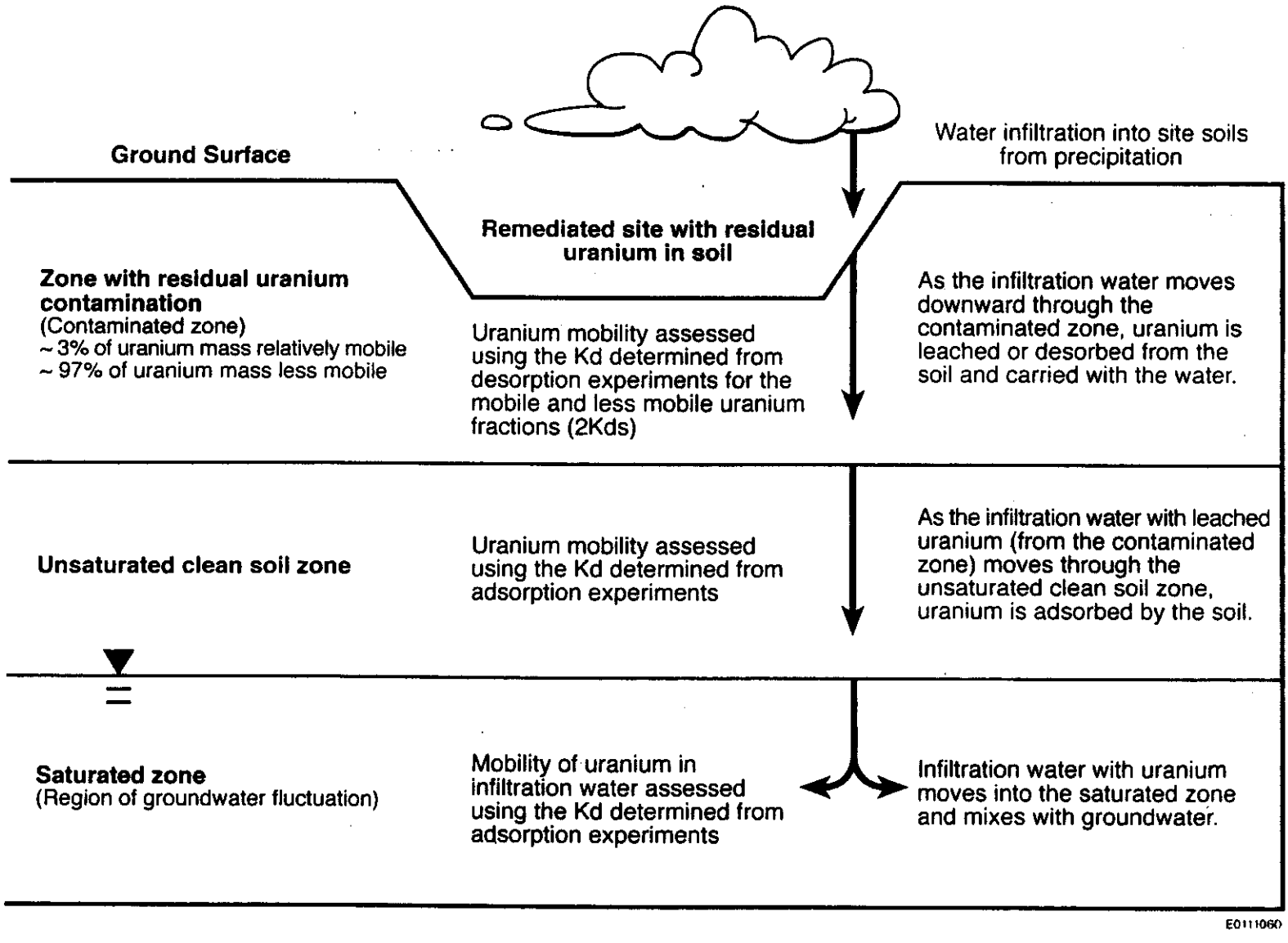
Proposed Additional Batch Leach (Desorption) and Adsorption Uranium Testing for Kd Value Refinement.

Additional batch and column desorption and adsorption uranium testing is proposed to further develop and refine the Kd data presented above for use in RESRAD modeling. These tests and methods (presented above and below) for Kd development are well founded within scientific literature including EPA's *Understanding Variation in Partition Coefficient, Kd, Values* (EPA 402-R-99-004A&B) and are consistent with Kd development methods and recommendations presented in the *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD* (ANL/EAD/LD-2). The recently amended Washington State MTCA rules (February 2001) also provide a regulatory basis for developing Kds using these methods [WAC 173-340-747(5)(b)(iii)].

We are proposing to conduct additional batch testing using procedures similar to the ASTM D 4793-93 or 4319-93 sequential batch procedures. These procedures involve placing soil and water in a container followed by mixing. The soil and water is mixed by rotating or shaking. The mixing duration depends on the length of time necessary to achieve consistent results. During testing, the tests are monitored by extracting leachate at time intervals with leachate analysis for parameters of interest. This is done sequentially, i.e., leachate is extracted at time intervals, until successive leachate concentrations are consistent.

Additional column tests similar to those tests previously conducted are also proposed. These tests will be conducted with project soil containing uranium and clean water (Desorption; solid to liquid) and with water containing uranium and clean soil (Adsorption; liquid to solid). For the additional tests with uranium contaminated soil, soil where the readily leachable fraction of uranium has been leached away and soil where the readily leachable fraction of soil remains will be used in testing. Additional detail regarding additional testing is included in the FY02 Proposed Work document.

URANIUM SOIL-TO-GROUNDWATER CONCEPTUAL SITE MODEL



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ATTACHMENT B

CONTROLLED LABORATORY TEST SAMPLING AND ANALYSIS OVERVIEW

APPENDIX B

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CONTROLLED LABORATORY TEST SAMPLING AND ANALYSIS OVERVIEW

The purpose of this appendix is to provide an overview of the sampling and analysis activities that are anticipated with implementation of the controlled laboratory tests. Based on results of the data quality objective (DQO) process, a staged approach was developed for the controlled laboratory tests to determine the leach rate and partition coefficient (K_d) values for uranium. Results of the controlled laboratory tests will be documented in a final report that includes conclusions and any limitations associated with the reported data.

STAGE 1

Stage 1 includes characterization of the source material that was collected in the field followed by the initial "scouting" leach tests, as presented in the following steps.

Step 1.1 – Source Material Characterization

The source material will be analyzed to identify physical/chemical characteristics of the soil and to determine the form of uranium present. Each of the five target levels of source material will be analyzed for the parameters identified in Table B-1. The turnaround time for the source material characterization is estimated to be 6 weeks.

Table B-1. Source Material Characterization Summary.

Test	Method	Quality Control
Uranium, phosphorous, other elements	XRF	Each sediment run in duplicate; one control sample.
Particle size	Dry sieve	N/A
Organic/inorganic carbon	Carbon analyzer	Each sediment run in duplicate.
pH	Electrode	One of five target levels run in duplicate.
Moisture content	1:1 water extract	One of five target levels run in duplicate.
Uranium form	Semi-selective chemical extraction	Each sediment run in duplicate.

N/A = not applicable
XRF = x-ray fluorescence

Step 1.2 – "Scouting" Leach Tests

For the scouting leach tests, one 15.2-cm (6-in.)-diameter by 15.2-cm (6 in.)-length column will be filled with source material for each of the five target levels (five columns). Simulated Hanford Site rainwater (based on historical test results of actual local rainwater) or deionized water will be used to conduct the leach tests (deionized water will produce more conservative results than simulated rainwater) with a residence time of at least 168 hours for each pore volume. It is anticipated that at least 10 pore volumes of simulated rainwater will be passed through each of the five loaded columns. The leachate solution will be collected from each column at regular intervals and analyzed for the parameters identified in Table B-2. It is estimated that as many as 24 leachate samples may be collected and analyzed from each column.

Table B-2. Scouting Test Leachate Characterization Summary.

Test	Method	Quality Control
pH	EPA-9045	One duplicate and 1 control sample for every 20 leachate samples.
Electrical conductivity	Electrode	One blank, 1 duplicate, and 1 control sample for every 20 leachate samples.
Uranium (mass)	ICP/MS	One blank, 1 duplicate, and 1 control sample for every 20 leachate samples.

ICP/MS = inductively coupled plasma/mass spectrometry

Based on the variability of results from the tests identified in Table B-2, composite samples of the leachate within each column will be prepared (i.e., leachate samples from multiple target levels will not be composited) to support geochemical solubility and speciation calculations. Each of the composite leachate samples will be tested for the parameters identified in Table B-3. The turnaround time for the scouting leach tests is anticipated to be approximately 21 weeks.

Table B-3. Composite Leachate Characterization Summary.

Test	Method	Quality Control
Anions	Ion chromatography	One blank, 1 duplicate, and 1 control sample for every 20 leachate samples.
Cations	ICP	One blank, 1 duplicate, and 1 control sample for every 20 leachate samples.
Alkalinity	Titration	One blank, 1 duplicate, and 1 control sample for every 20 leachate samples.

STAGE 2

Stage 2 of the controlled laboratory tests includes continued duration leach tests and the initial adsorption tests, as presented in the following steps.

Step 2.1 – Batch Leach Tests

Based on the results from the scouting leach tests (showing that a small portion of the uranium readily leached in the first few pore volumes and then the leaching approached a slow continual release of the remainder), batch leach tests will be performed to better define an equilibrium (or at least steady-state) desorption K_d for the recalcitrant majority of uranium in the sediments. At a minimum, batch leach tests will be performed for 150 days or until June 2002, with periodic sampling of leachate to learn when steady-state uranium concentrations are reached. The five contaminated sediments that have already been leached in the flow-through column test will be used in the batch leach tests. The flow through column tests will be stopped and approximately 450 g of wet sediment from the influent end of the columns will be well mixed and split into the following three batches:

- 100 g oven-dry sediment per liter of rainwater
- 100 g oven-dry sediment per liter of vadose zone pore water (saline solution equivalent to fluids from the flow through portion of the leach tests)
- 100 g oven-dry sediment per liter of groundwater

Moisture content of the wet sediment will be determined and a small portion will be oven dried for determination of the total uranium content using x-ray fluorescence. During the test, containers will be gently rocked or contents will be occasionally stirred/sparged with air. Samples will be collected at the end of 2, 4, 7, 11, 15, and 21 weeks) by removing 15 mL of leachate and replacing it with 15 mL of fresh solution. Electrical conductivity, pH, and uranium will be measured for each sample collected. Anions and alkalinity will be measured for samples collected at the end of weeks 4, 11, and 21 only. The desorption K_d will be calculated as a function of time for each sediment and each solution type.

Step 2.2 – Perform Batch Adsorption Tests

Because results from the flow through leach tests exhibited a wide range of uranium concentrations, batch adsorption isotherm tests will be conducted to help guide the interpretation of the proposed column tests. Two sorption isotherms will be developed using solutions representative of the groundwater vadose porewater chemistry (with saline composition similar to the first leachates from the 2001 leach tests) to determine whether the adsorption follows a linear isotherm and, thus, yields a constant sorption K_d value. These two end member solutions will consist of mixtures of calcium, magnesium, sodium, sulfate, and bicarbonate. The more saline solution will have 20 meq/L of total cations and anions, and the dilute solution will have 2 meq/L of total cations and anions. Both solutions will be set at pH equal to 7.5 (the average pH of all the leachates from the 2001 tests and a value representative of the 300 Area groundwater in

the vicinity of the uranium plume). Aliquots of each solution will be spiked with five different concentrations of uranium(VI) ranging from 30 ppb to 70 ppm (representative of the drinking water standard to the most concentrated leachates from the 2001 tests).

Duplicate batch adsorption tests will be run using background sediments that will have been rinsed twice with the two uncontaminated solutions to remove natural uranium that is readily dissolvable and to adjust the pH to approximately 7.5. The solid to solution ratio for all isotherm tests will be fixed at a ratio to be determined from preliminary tests (a likely ratio will be 5 g of sediment to 50 mL of solution). The contact time for the batch test will be 72 hours to allow adequate time for equilibration. The tests will be run for total of 168 days and pH and uranium content rechecked.

To determine the variation in uranium K_d versus the two most sensitive parameters (pH and carbonate concentration), two additional suites of batch adsorption tests will be performed. For the pH tests, the two solutions from the batch isotherm tests will again be used. Two of the uranium concentrations will be selected, and three batches of each of the solutions will be pH adjusted to 6.5, 7.5, and 8.5. The effects of bicarbonate concentration on uranium K_d will be determined using batch tests where two solutions of sodium-bicarbonate-sulfate with fixed ionic strengths of 1 and 20 meq/L will be prepared at three different levels of bicarbonate. For the 2 meq/L solution, the bicarbonate suite will be set at 0.5, 1, or 2 meq/L. For the 20 meq/L solution, the bicarbonate concentration will be fixed at 2, 8, or 16 meq/L. The pH will be fixed at 7.5 for all solutions. The same solid-to-solution ratio, prewashing steps, and contact times will be used as for all the batch tests. For all of the batch adsorption tests, the initial and final uranium concentrations, pH, and alkalinity will be determined such that the uranium adsorption K_d can be determined and the sensitivity to uranium, pH, and bicarbonate concentration can be quantified.

Step 2.3 – Perform Flow-Through Column Adsorption-Desorption Tests

After variability of the uranium K_d to the uranium concentration, pH, and bicarbonate is determined (Step 2.2), flow-through tests to develop breakthrough curves for uranium adsorption onto the background sediment will be conducted. Columns with dimensions of approximately 4.1 cm diameter (inner) by 24.4 cm long filled with background sediment will be used. It is anticipated that two different uranium-bearing solutions will be used to run flow-through column tests. Each column will be "pre-flushed" over a 7-day period with a "clean" solution that has the same chemical composition, but without uranium, as the two different uranium-bearing solutions. The purpose of a pre-flushing step is to achieve equilibrium for the background sediments and to leach the readily removable natural uranium from the background sediment.

It is estimated that each column test will run for 180 days with 7 days of pre-flushing, 42 days of injection of uranium-traced solutions at a flow rate of 0.07 pore volume per day, and 131 days of rinsing with the same solution without uranium tracer. Flushing with the clean solution will determine the desorption rate for the uranium and evaluate reversibility. An adsorption K_d and a desorption K_d will be determined to for potential use in transport models that can accommodate sorption hysteresis. An average of five adsorption fluid samples will be collected for each pore

volume when there is uranium breakthrough action, and one sample will be collected for each pore volume when there is no breakthrough (or slowly increasing breakthrough). Up to 50 adsorption fluid samples from each column will be analyzed in accordance with analyses specified in Table B-4.

Table B-4. Adsorption/Desorption Fluid Characterization Summary.

Test	Method	Quality Control
pH	EPA-9045	One duplicate and 1 control sample for every 20 leachate samples.
Electrical conductivity	Electrode	One blank, 1 duplicate, and 1 control sample for every 20 leachate samples.
Uranium (mass)	ICP/MS	One blank, 1 duplicate, and 1 control sample for every 20 leachate samples.

In addition to the characterization analyses from Table B-4, selected adsorption fluid samples will be analyzed for the common cations and anions in accordance with Table B-3.

The objectives of the column tests are to verify the adsorption K_d for uranium for two specific conditions and to address desorption tendencies of uranium for recently adsorbed uranium. The desorption results will likely be conservative values (lower than desorption values) for uranium that has been sequestered by sediments for several tens of years. If significant hysteresis is observed between the adsorption K_d and the desorption K_d, it would be appropriate to run RESidual RADioactivity (RESRAD) dose modeling or other models with two types of K_d values for the originally clean (or deeper sediments) or at least argue that adsorption K_d values overestimate migration of the uranium to the water table.